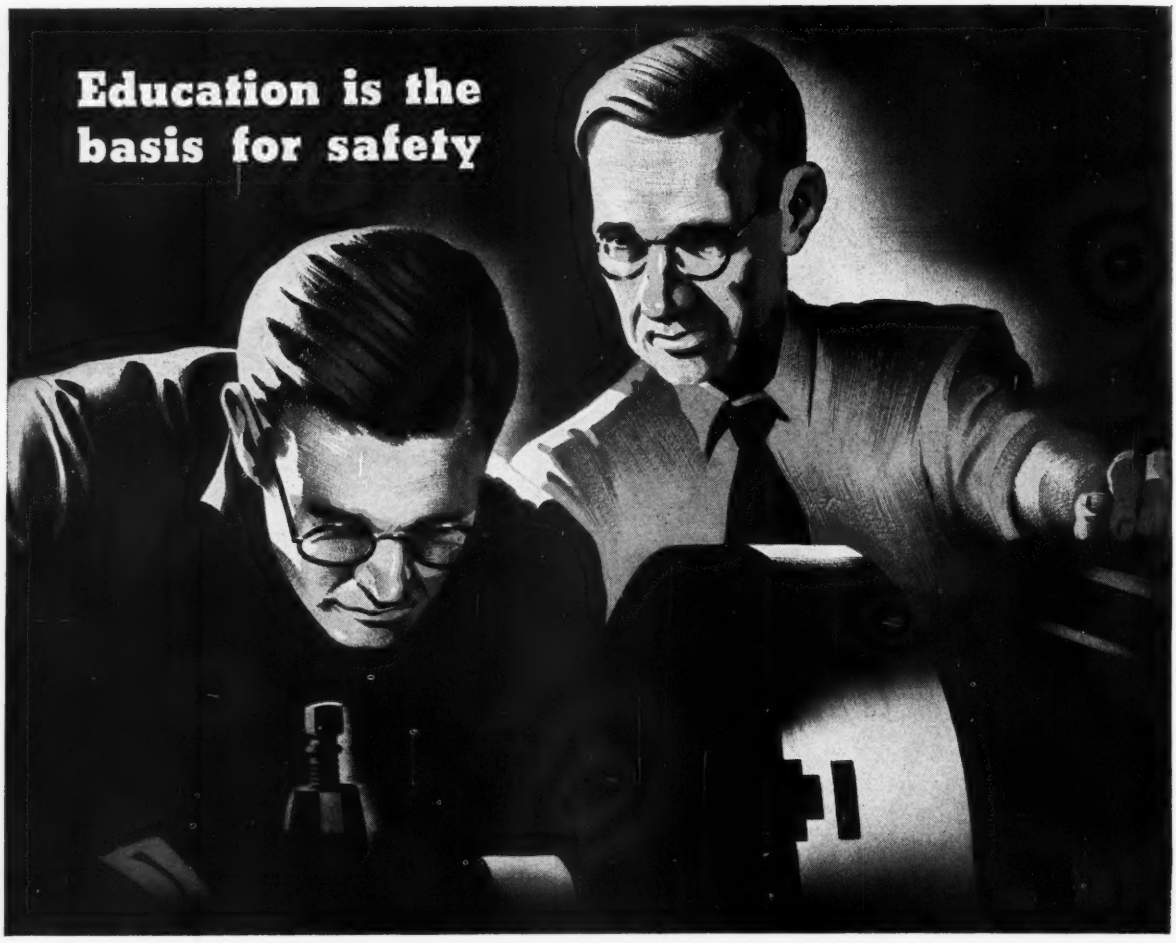
THE CORNELL ENGINEER

COLLEGE OF ENGINEERING · CORNELL UNIVERSITY



Information supplied by the National Safety Council

Labor, particularly inexperienced labor, cannot be expected to recognize the full penalties of carelessness in the shop. Management has assumed the responsibility of supervising safety measures, and has cooperated in establishing sound safety rules.

Nevertheless, the large increase in labor personnel due to war needs, plus the influx of inexperienced men, have resulted in a substantial increase in lost time accidents.

Even assuming that the obvious safety measures with regard to operating machinery, electrical equipment and shop traffic have been installed, two factors — education and eternal vigilance — determine the real effectiveness of any safety program.

Both are the responsibility of the supervisory staff, from foremen up. The foreman who does a thorough job of educating his particular group in safety rules and cooperative enforcement has done much to cut down accidents. Management that takes an active interest in both safety education and the enforcement of safety measures has taken a great step forward in reducing wastage of irreplaceable production time.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Mo-lyb-den-um Company
500 Fifth Avenue • New York City

MOLY

Ad No. 283

HE SPECIALIZES IN "BIG STUFF."
L. A. Kilgore has been designing electric generators, rectifiers, and motors ever since he joined Westinghouse . . . but his 40,000 h.p. Wright Field wind-tunnel motor tops them all. Kilgore received his E. E. at the University of Nebraska and his M.S. at the University of Pittsburgh.

The hurricane that shapes an eagle's wings.

THE LIGHTNING SPEED of the modern warplane has brought a lot of headaches to aircraft designers.

Wind-tunnels, the "proving grounds" of aviation, were satisfactory for studying the performance of the lighter, slower planes of yesterday. But they were not adequate for today's fighter planes . . . with top speeds of *over 400 miles per hour.*

To investigate the terrific forces at work at these high speeds, the U. S. Army demanded a wind-tunnel that would produce a tornado many times greater than Nature's wildest gale.

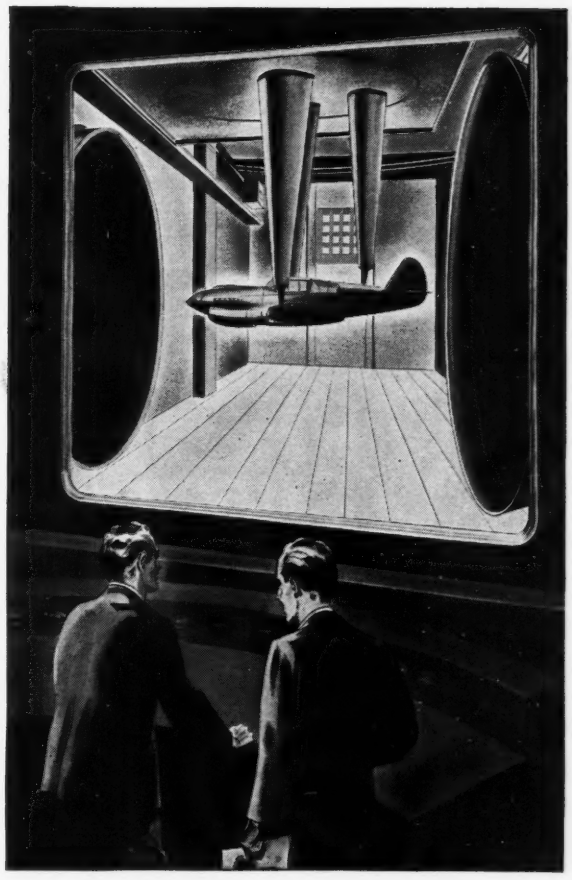
Army officials asked Westinghouse to take over the job of *building the electric motor* to drive the fans in this tunnel.

The two fans were to be truly colossal . . . 40 feet across, with a combined weight of nearly 150 tons. They were to be mounted on a 16-inch solid steel shaft, 120 feet long. Merely starting this great mass in motion, with minimum disturbance to the power system, was the toughest kind of engineering problem.

To complicate the problem further, a wide range of air speeds is required for wind-tunnel testing. And at each air speed the motor speed must be held constant, regardless of fluctuations in the electric power lines.

L. A. Kilgore . . . in collaboration with J. C. Fink . . . tackled the problem. In twelve months these Westinghouse engineers designed and supervised the construction and installation of a 40,000 hp wound-rotor induction motor . . . world's largest of its kind . . . an installation that met every Army requirement.

That 40,000 horse power motor . . . a direct result of Westinghouse "know how" . . . is now in service in the new $2,500,000 wind-tunnel at Wright Field. Large airplane models and actual-size motors, with whirling propellers, are tested and studied in its 400-mile-an-hour windstream.



• • •

Kilgore and Fink have given vital aid to winning the war . . . for they have helped to make it possible for Army experts to learn many new facts about plane performance and plane design, facts of utmost importance in gaining and maintaining air supremacy over the Axis.

Today the need for engineers is very great. Of the 300 young engineering graduates who joined Westinghouse last spring, many are already showing great promise in engineering.

Westinghouse looks to the Class of '43 for its future scientists and engineers.

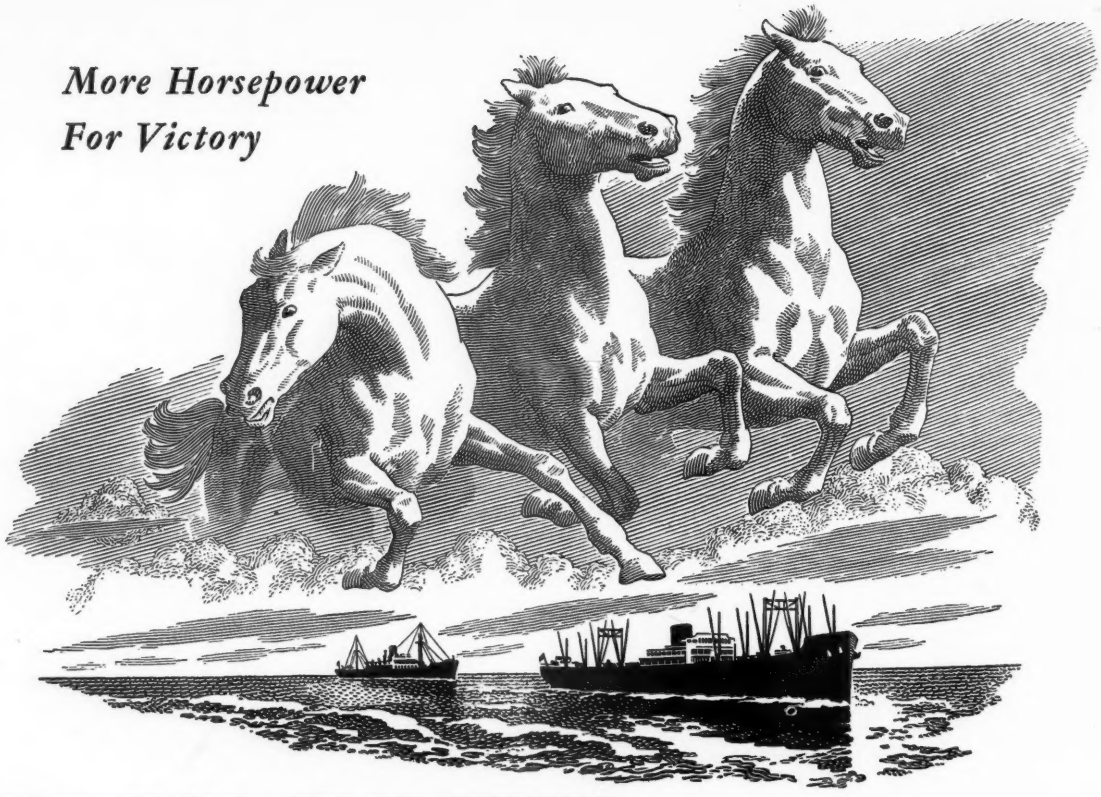
• • •

THE WESTINGHOUSE ENGINEER . . . a quarterly magazine brimful of interesting articles on electronic research and electrical engineering . . . keeps you posted on the latest scientific developments. Profusely illustrated. Subscription, only 50¢ a year. Address: Westinghouse Electric & Manufacturing Company, Department 6N-17, East Pittsburgh, Pennsylvania.

Westinghouse

. . . MAKING ELECTRICITY WORK FOR VICTORY

More Horsepower
For Victory



FIRST COME, FIRST SERVED...
RIGHT NOW OUR ARMED FORCES COME FIRST

The Busch-Sulzer organization to a man is working 'round the clock on equipment for our fighting men and for high priorities only. That we are working as satisfactorily for your government as we have through the years for our good civilian friends is shown by the Navy E burgee on our flag staff.

Busch-Sulzer is the oldest builder of Diesels in America. In the first world war we built Navy Diesels and, in the present conflict, we have greatly expanded our personnel and facilities to meet Navy requirements. Our plant now is being surveyed by consulting engineers to determine how best our facilities can be devoted to producing engines of peace once the need for engines of war has been met.

BUSCH-SULZER BROS.-DIESEL ENGINE CO.
BRANCHES:
NEW YORK CITY SALES OFFICE, TWO RECTOR ST.
SAN FRANCISCO SALES OFFICE, RIALTO BUILDING

BUSCH-SULZER
ST. LOUIS

America's Oldest Builder of **DIESEL ENGINES**

Editor-in-Chief
E. W. Ross, ME '43

* *

Business Manager
R. H. Flack, ME '43

* *

Managing Editor
C. H. Loughridge, Jr., ME '43

* *

SENIOR PUBLICATION BOARD

Assistant Editor
M. R. Sfat, ChemE '43
Associate Editor
C. H. Barnett, AE '43
Advertising Manager
M. Bradt, Jr., AE '43
Circulation Manager
E. F. Filby, CE '43
Treasurer
T. T. Harrow, CE '43

* *

JUNIOR PUBLICATION BOARD

Editorial
H. S. Burling, Jr., AE '44
H. F. Ferry, Jr., ME '44
M. L. Garritt, CE '44
D. R. Lueder, CE '44
J. H. McMinn, CE '44
R. S. Rochlin, EE '44
G. R. Schiller, ChemE '45
Business
T. H. Dent, III, ME '44
D. H. Esperson, ME '44
G. H. Ficken, ME '44
M. L. Gleich, CE '44
K. A. Kander '44
R. B. Shaad '44

* *

ADVISORY BOARD

Prof. S. C. Hollister, Dean

Technical Advisers
Prof. R. Y. Thatcher, C.E. '09
M. W. Sampson, B.S., A.E. '39

School Directors
Prof. W. A. Lewis, Jr., EE
Prof. W. N. Barnard, ME
Prof. W. L. Malcolm, CE
Prof. F. H. Rhodes, ChemE

Faculty
Prof. A. S. Adams, Ass't. Dean
Prof. M. G. Malti, M.E.E. '24
Prof. J. E. Perry, C.E.
Prof. C. I. Millard, E.E. '26
Prof. C. C. Winding, B.Chem.E.

Alumni
R. E. Clark, M.E. '13
C. H. Davidson, C.E. '11
W. E. Kennedy, M.E. '12

Founded 1885

The CORNELL ENGINEER

Volume 8 NOVEMBER, 1942 Number 2

Contents

Imagineering for Victory 5
Professor J. R. Bangs

The Versatile Infra-red Ray 6
Robert S. Rochlin, EE '44

Men and Ships 9
David Gaehr, M.E. '01

News of the College 13

Personalities on the Hill 14

The Alumni 16

President's Message 18

Stress and Strain 28

Cover: See story on page 6 (*Courtesy Westinghouse*)

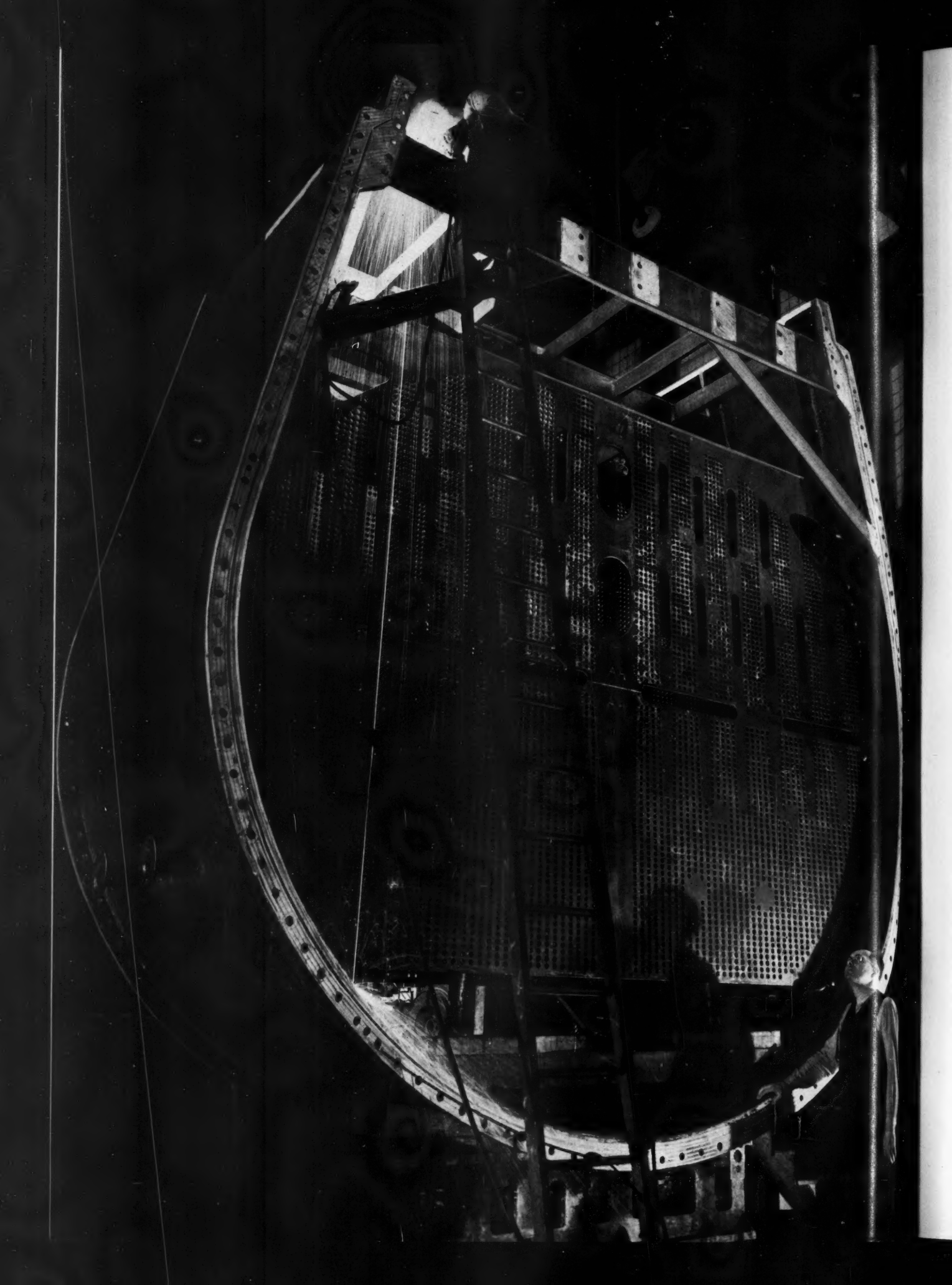
Frontis: Assembling one of the three sections of a 35,000 sq. ft., two pass steam surface condenser.
(*Courtesy Allis-Chalmers Electrical Review*)

Members of The Engineering College Magazines Associated
Chairman: **Robert L. Taylor**
Monsanto Chemical Co., St. Louis, Missouri

Arkansas Engineer
Colorado Engineer
Cooperative Engineer
Cornell Engineer
Drexel Technical Journal
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Missouri Shamrock
Nebraska Blue Print
New York Univ. Quadrangle
North Dakota State Engineer
Ohio State Engineer
Oklahoma State Engineer
Oregon State Technical Record
Pennsylvania Triangle
Purdue Engineer
Rose Technic
Tech Engineering News
Univ. of North Dakota Engineer
Villanova Engineer
Wayne Engineer
Wisconsin Engineer

Published monthly—October to May—by the **Cornell Engineer, Inc.**, Ithaca, N. Y. Edited by the undergraduates of the College of Engineering, Cornell University. Entered as second class matter at the Post Office at Ithaca, N. Y., under section 103, Act of October 3, 1917.

Subscription per year: regular $1.50; with membership in the Cornell Society of Engineers $2.00 (See President's page); student $1.00; single copy $.20.



Imagineering For Victory

By J. R. BANGS, Jr., M.E. '21

Head of Administrative Engineering Department

A VERY few weeks ago a 10,500 ton ship was launched just ten days after the keel was laid, and was outfitted and delivered in a total of 14 days. Behind this all-time record lies a story which is both a tribute and a monument to the inventiveness, skill, and engineering genius of America.

In an effort to find a term which would adequately describe the men behind this endeavor, the author has selected the coined word, "Imagineers". The imagineer is one who lets his imagination soar and then engineers it down to earth. He is alert, resourceful, possessed of initiative and fundamental engineering knowledge, usually young, and is totally unafraid to try something new. In order to see just what imagineers have accomplished, both in ship-building and aircraft production, let us examine the record.

In 1939, when the first contracts for what is now known as the "Liberty Ship" were let, the entire shipbuilding industry of the United States employed 42,000 people. In January, 1942, this figure had become 550,000, and it is expected that it will reach 850,000 by the beginning of 1943. It was estimated by the Maritime Commission that these vessels would require 105 days to build and launch, the estimates being based on the traditional ship-building methods in use since the time of Noah. It is obvious that a precedent-breaking revolution in methods coupled with a gigantic training program is responsible for the ten-day record recently set, and for the heretofore unheard-of number of weekly launchings.

The imagineer first entered the picture when the need for training thousands of new workers arose. It was evident that a shortage of time prevented the training of skilled ship-wrights; the job was therefore broken down into simple operations which could be performed after a minimum period of instruction. The job was also spread out to the extent that the building of a ship has become the fabrication of a number of sub-assemblies by workers who perform a very few tasks over and over again, the transportation of these sub-assemblies to the ship-ways, their assembly there into a nearly completed ship, and the launching of this, to be followed immediately by the keel-layers of another. Entire superstructures are pre-fabricated, complete in every detail, to be placed on the hull, which has also been built up of pre-fabricated sections.

Welding is to be thanked for a great part of the record; it has resulted in great savings of time and material. Women, even in such posts as straw-bosses and higher, are employed to a great extent in western shipyards. Or perhaps that is the wrong term. An old Scotch ship-builder, born and bred in the yards of the Clyde, summed up the entire situation by remarking "Hell, mister, them's not shipyards; them's ship-factories."

It was the men who built the big dams—Grand Coulee, Bonneville, and others, who imagineered these ships; they didn't know too much about the traditional methods of ship-building—in fact it is said that Henry Kaiser employs two old-time shipbuilders whom he keeps locked up so that they cannot do any harm. But these men had the experience, the know-how, and the immediate availability to them

(*Continued on page* 22)

THE AUTHOR

AFTER an extensive western tour in which he visited shipyards and airplane factories, Professor Bangs returns to tell us of the production miracles being worked by the "Imagineers."

Well known not only as head of the Administrative Engineering Department, Professor Bangs is also serving as Technical Consultant of the War Manpower Commission.

During his undergraduate days, he was president of Tau Beta Pi and was a member of Atmos, Theta Alpha, Sphinx Head, Phi Kappa Phi, Kappa Tau Chi, and Spiked Shoe.

The Versatile Infra-red Ray

By ROBERT S. ROCHLIN, EE '44

THE hour is midnight. Into the shadow of a huge munitions plant creeps a stealthy figure. After waiting for the guard to turn the corner, the prowler scales the wall and darts toward the building. Suddenly a beam of light shoots out of the darkness, and before he can flee, several guards have converged upon him effecting a quick capture.

For catching this would-be saboteur we must thank the invisible rays known to science as infra-red radiation. As he scaled the wall, the intruder unknowingly interrupted an infra-red beam which had been activating a photoelectric cell. Instantly an alarm sounded in the guard house, and a lamp on a panel revealed his exact location.

Infra-red radiation was discovered in 1800, when Sir William Herschel found that a blackened thermometer bulb became hot when placed beyond the red end of the sun's visible spectrum. These rays have now been used for countless purposes, many of which we shall survey in this article.

A wide and fascinating group of applications arises from the fact that many pairs of substances which reflect ordinary light identically differ in their reflection of infra-red. Thus criminologists can often detect forgeries and counterfeits by taking infra-red photographs of a genuine sample and of the one under question, although the two appear identical otherwise. Art dealers can similarly judge the authenticity of old paintings.

If an ink or pigment partly transparent to infra-red is applied over one which is more opaque to it, the underlying writing or painting will show up in an infra-red photograph. This fact has been used in deciphering writing obliterated by censors or forgers, and to reveal alterations in paintings. In this manner, for example, Dr. L. Bendikson was able to make legible passages from "de Bry's Voyages" which were deleted 300 years ago by the official censor of the Spanish inquisition, even though the deletion ink was very dense, and so thick it could be felt with the fingers. (Fig. 2).

It is often possible to decipher charred documents, letters, money, etc., with infra-red. Although to the eye the whole paper appears equally black, the tiny residue of ink reflects infra-red differently than the paper ash. Where writing has been chemically bleached, the product which results from the reaction of ink and bleach often absorbs more infra-red than the surrounding paper. Infra-red thus serves to reveal the hidden writing.

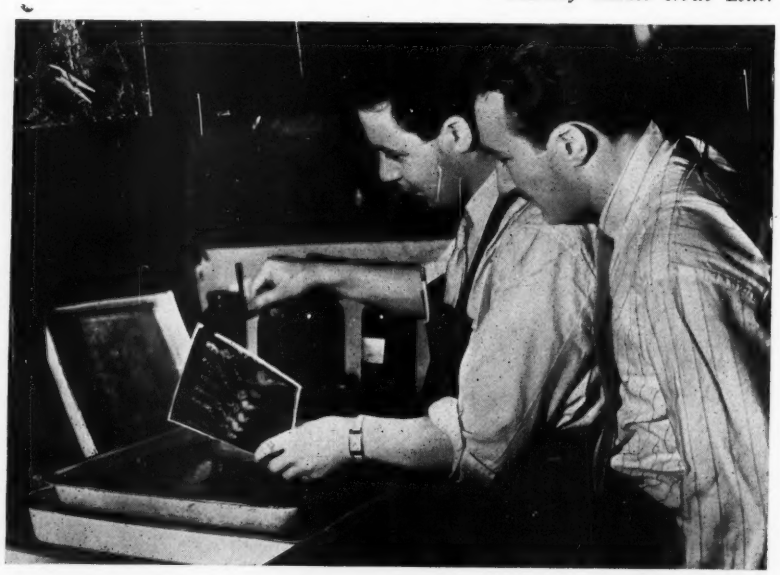
The transparency of the human skin to infra-red is a boon to the medical profession. It enables doctors to make photographs which show conditions immediately under the skin, which in turn aids in the examination of certain tumors, diseased eyes, skin lesions, and other disturbances.

But the most common use of infra-red for penetrating where the eye cannot is that of "seeing" through haze and fog. It is known that particles of water vapor in the air scatter light. Infra-red is scattered less than visible light, because of its longer wave-length.

The advantages of infra-red for aerial photography have long been recognized. The airplane must fly high enough to include sufficient territory in one photograph, and to eliminate blurring caused by the plane's motion. At this height atmospheric haze would be a serious handicap were it not for infra-red. For example, Captain A. W. Stevens of the U. S. Army took an infra-red photograph of Mt. Shasta from an airplane when the visibility was only ten miles, but the mountain showed up clearly—331 miles away.

Infra-red does not penetrate all fogs alike. Through a fog made up of moisture, soot and smoke (such as is commonly found over dry land), infra-red penetrates about three times as well as the eye. But through a fog made up only of moisture (the type practically always found at sea), infra-red penetrates ten times as far as the eye. Hence infra-red is prov-

Fig. 1. Taken in a dark room by infra-red without fogging the print.
—Courtesy Science News Letter



ing an invaluable aid to maritime navigation. A camera has been developed by Captain Flavel M. Williams which will show an infra-red picture of a ship's course twice every minute.

At this point it might be well to enumerate the different ways in which infra-red radiation can be detected. As already mentioned, it registers on photoelectric cells and special infra-red sensitive photographic film, although ordinary film and the human eye cannot detect it.

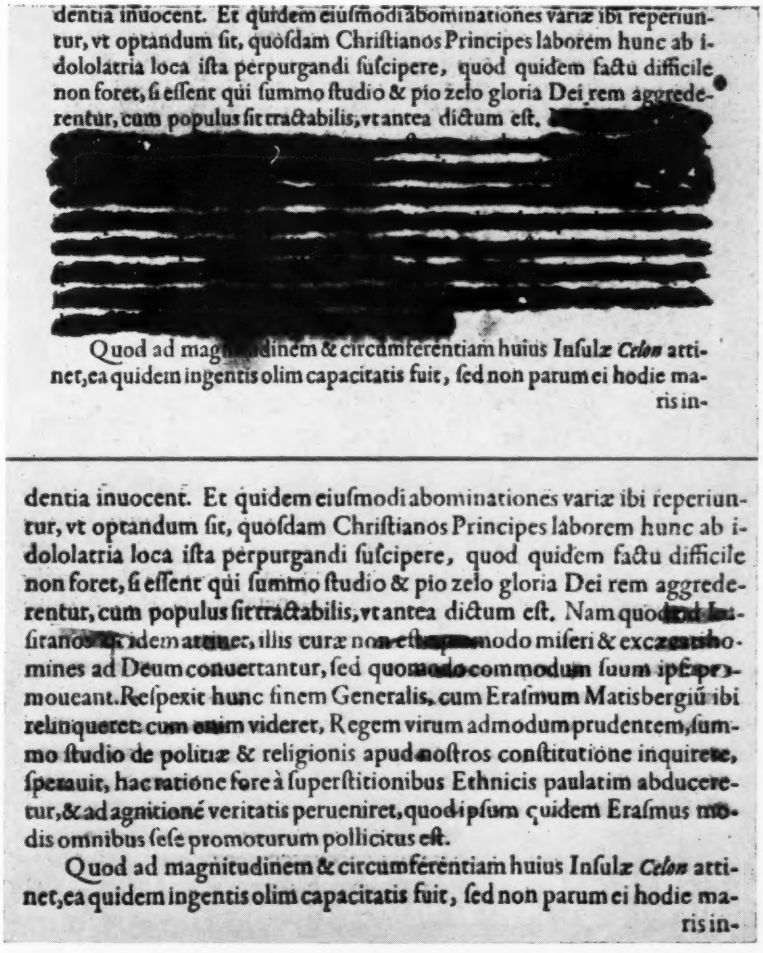
The mere presence of infra-red can be shown by a delicate temperature-measuring device such as a thermocouple, a bolometer (which measures the change in electrical resistance of a small metal strip when heated by infra-red), or a radiometer (which consists of delicate vanes which are moved by the increased rebound of gas molecules when one side is warmed by the rays). These methods are used in spectroscopic work over 9800 Angstrom units, where photographic sensitivity becomes low. A thermoelectric sextant has been developed which will accurately determine the position of the sun through thick obscuring clouds. It can detect the heat emanating from a man's face a mile away.

A method was still needed, however, which would instantaneously make visible entire infra-red images. Dr. Vladimir K. Zworykin developed such a method in 1936. His device consists of a large evacuated tube, with a cesiated silver screen at one end and a larger fluorescent screen at the other. Infra-red rays, focused by suitable lenses, fall on the cesiated silver screen, causing the emission of electrons. These form an "electron image" close to the surface. Normally the electrons would scatter in all directions, but, focused by electric fields in a manner similar to that used in the electron microscope, they cast their image on the nine inch fluorescent screen, where the image becomes visible. Attached either to a telescope or a microscope, this device reproduces images with good resolution and fidelity. It also permits various degrees of magnification.

The vast possibilities of this instrument can well be imagined. An airplane pilot can use the device to see an airport's beacons through fog. It permits biologists to watch moving organisms by infra-red under the microscope. Coupled with huge infra-red searchlights, it enables ground troops to detect enemy aircraft in spite of fog or darkness, and without revealing their own position. Other military applications, such as night aerial surveys, detection of battleships through smoke screens by their hot funnels, etc., can be readily imagined, although the details of present uses are, of course, closely guarded secrets.

Another large group of uses for infra-red arises from its very invisibility. The possibility of taking pictures in the dark not only appeals to the amateur photographer who is looking for amusing "candid" snapshots, but it is also an important asset to newspaper camermen, who are enabled to carry on their work in blackouts, theatres, nightclubs, courtrooms, lectures, symphony concerts, and other places where the glare of a flash bulb would be annoying or forbidden (Fig. 1).

Protection of defense plants by a network of invisible beams actuating photoelectric cells, has been developed to a high degree of perfection, as mentioned at the beginning of this article. The first refinement was to change from visible light beams, which a prowler could see and avoid, to a criss-crossing network of invisible infra-red beams. Using inconspicuously placed mirrors, the beams can turn corners, blocking every approach. Each beam is accurately aimed at its cesium-oxide photocell, so that sunlight or an intruder's flashlight can



dentia inuocent. Et quidem eiuſmodi abominationes variæ ibi reperiuntur, vt optandum ſit, quoſdam Chriſtianos Principes laborem hunc ab idololatria loca iſta perpurgandi ſuſcipere, quod quidem factu difficile non foret, ſi eſſent qui ſummo ſtudio & pio zelo gloria Dei rem aggrederentur, cum populus ſit tractabilis, vt antea dictum eſt.

Quod ad magnitudinem & circumferentiam huius Inſulæ *Celon* attinet, ea quidem ingentis olim capacitatis fuit, ſed non parum ei hodie maris in-

dentia inuocent. Et quidem eiuſmodi abominationes variæ ibi reperiuntur, vt optandum ſit, quoſdam Chriſtianos Principes laborem hunc ab idololatria loca iſta perpurgandi ſuſcipere, quod quidem factu difficile non foret, ſi eſſent qui ſummo ſtudio & pio zelo gloria Dei rem aggrederentur, cum populus ſit tractabilis, vt antea dictum eſt. Nam quod [illegible] Inſulanos attinet, illis curæ non eſt [illegible] modo miſeri & excæcati homines ad Deum conuertantur, ſed quomodo commodum ſuum ipſi promoueant. Reſpexit hunc finem Generalis, cum Eraſmum Matisbergiũ ibi relinqueret: cum enim videret, Regem virum admodum prudentem, ſummo ſtudio de politiæ & religionis apud noſtros conſtitutione inquirere, ſperauit, hac ratione fore à ſuperſtitionibus Ethnicis paulatim abduceretur, & ad agnitionẽ veritatis peruenirent, quod ipſum quidem Eraſmus modis omnibus ſeſe promoturum pollicitus eſt.

Quod ad magnitudinem & circumferentiam huius Inſulæ *Celon* attinet, ea quidem ingentis olim capacitatis fuit, ſed non parum ei hodie maris in-

—Courtesy Dr. L. Bendikson

Fig. 2. (above) As passage appears to eye. (below) Passage photographed by infra-red.

not deceive it. Any attempt to put the flashlight into the position necessary would break the beam, and thus give the alarm before the flashlight could strike its mark. (Fig. 3).

Some installations have even more ingenious arrangements. A small metal disc, revolving at high speed in front of the infra-red source, chops up the outgoing beam into thin slices of a definite pattern. The photocell is adjusted to receive a signal of the same vibration, and ignores all other lights.

One can envisage numerous military applications for these beams, such as setting off mines at harbor entrances or in land engagements. They are ideal for fences around airports since they are no hazard to low flying planes.

Scientists have been able to acquire valuable spectroscopic information from infra-red which would not be otherwise obtainable. They have discovered, for instance, that the upper layers alone of Venus' atmosphere contain 10,000 times as much carbon dioxide as the entire atmosphere of the earth, and they have found ammonia and methane on Jupiter and Saturn.

It is known that infra-red rays are emitted by bodies which are not hot enough to give off visible light. Using infra-red film, astronomers can photograph stars as cool as 1000°, although the stars below 2000° are not visible to the eye.

Infra-red photographs are valuable also in engineering for studying the temperature distribution of bodies just below red heat, such as stoves, engine parts, cooling castings and ingots, high pressure boilers, flatirons, etc.

In this discussion we should not neglect the esthetic side of the picture. The professional and amateur photographer can often obtain pictures of unusual beauty and appeal by using infra-red film. In an infra-red photograph taken in bright sunlight, bright blue sky appears black, showing beautiful cloud effects, and green foliage appears white. An infra-red photograph taken in bright sunlight and printed slightly darker than normal gives a realistic illusion of brilliant moonlight. In fact, the motion picture industry has saved millions of killowatt-hours by taking "night" scenes in just this way.

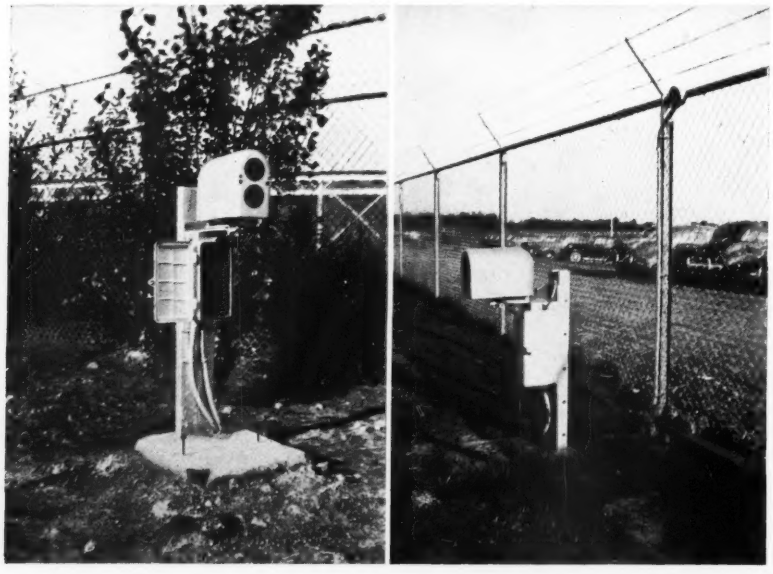
For years engineers have been trying to produce a more efficient incandescent lamp,—one that would convert more of its energy into light and less into the infra-red, heat producing rays. Now, however, they have turned about and produced a lamp which is so efficient as a heating unit that it has replaced conventional furnaces for scores of industrial operations. For example, infra-red lamps can dry electric motor and transformer windings three times as fast as the conventional oven (see cover); they can remove moisture from plastics about to be molded ten times faster than the formerly used steam drier.

This radiant heat has been found to provide the most efficient form of heat transfer, since it wastes no heat on intermediate bodies, while conduction and convection do. The infra-red lamps are the equivalent of an ordinary 220 volt lamp filament on a 110 volt line. Because of their comparatively low filament temperature, they have a life of about 10,000 hours.

Many an automobile owner has at times been vexed upon finding that the auto repair shop has painted an apple-green patch on his blue-green car. The only way hitherto known for matching the color was to use the original enamel, but that had to be baked on at the factory. Then some one got the bright idea of baking it on at the shop with a small portable bank of infra-red lamps. Now the manufacturers themselves send freshly painted cars through "tunnels" lined with the lamps. Infra-red is especially useful for paint drying because some of the rays penetrate the paint and heat the surface underneath, drying the paint from both inside and out.

Convenient and flexible, these lamps are used for drying printer's ink, adhesive on envelopes, blueprints, label paint on glass bottles, photographic film, etc. Foundry men have found that with infra-red lamps they could dry the top ½ inch layer of their sand. Conventional methods which dried the sand deeper caused it to shrink and lose the proper dimensions. The lamps are used to expand pistons while inserting close-fitting piston pins, and to heat the oil in delicate mechanisms which cannot be heated conveniently by ordinary methods.

Little did Herschel dream that his insignificant appearing little discovery would prove to be a boon to military forces, astronomers, movie-makers, doctors, airplane pilots, navigators, photographers, policemen, artists, librarians, engineers and a host of others, and through them, to all mankind.



—Courtesy Science News Letter

Fig. 3. Infra-red beam source (left) and photoelectric cell receiver (right) for a defense plant protection alarm system.

Men and Ships

By DAVID GAEHR, M.E. '01

No real American gives up his sense of personal responsibility to go to the limit in trying to fit in where he considers himself most valuable, until, by official channels, finally placed, and then he seeks promotion by more than filling his assigned "boots."

So, an earnest and farsighted student, looking toward life's and this war's "proving grounds", will quite naturally seek reliable standards of comparison for his faculties, training, and experience. He looks beyond the empirical formulae of text books, conventional standards of scholarship and commercialized "psycho-analyses", academic "job analyses", and records of "find yourself campaigns", into the reaches "where men are men" and dare to "call their souls their own", giving all they have without counting the cost.

From time immemorial this extraneous sizing up and calibrating has grated on the nerves of those seeking freedom and independence in, and by way of, gainful employment, but the process was far less painful and annoying to those starting in early to search and grade themselves, proud of national, family, and educational heritage, yet not thinking more of themselves than they ought.

In such fruitful introspection and investigation similies and metaphores have ever played an important role. The late Trustee Willard Beahan, C.E. '78, once introduced Ambrose Swasey, the famous telescope and machine tool builder, (partner of Mr. Worcester R. Warner, a one-time lecturer at Sibley, both intimate friends of Dr. Thurston), with this delightful and significant preamble:

> "Men are like trees; they differ from each other in a similar way. Some men are like the willow, constantly moving in every direction; some like the sycamore, bending gracefully to every breeze; others like the beech, always smooth outside and always poor in fiber; while there are still others that are like the oak, sturdy, stout-hearted, bristling with strength in every direction, and standing four-square to every wind that blows. I take great plesure in introducing Mr. Ambrose Swasey."

However, in times like these, when the need of speedily, yet well-built ships, and virile, "true-blue" Americans to man them is positively crucial, likening men to ships would seem both a more profitable and timely study.

Such a presentation can be made from two pairs of viewpoints: (1) that of the designer or builder; (2) that of the manager or operative; both equally instructive and inspiring.

Years ago a number of local Engineering Societies were affiliated in an association of engineering socities, which published a journal. In it appeared the most important papers presented in meetings of the constituent member societies. Of all these papers, none arrested the writer's attention more than an article on "The Man and the Ship", by Mr. George W. Dickie, the president of the Technical Society of the Pacific Coast, a prominent Naval Architect, and chiefly responsible for the building of the famous battleship Oregon. This ship is again in the popular "lime-

THE AUTHOR

AFTER serving as an apprentice machinist with the Warner & Swasey Company in Cleveland for four years, David Gaehr came to Cornell. Graduation in 1901 was his stepping stone to a series of positions ranging from draftsman, inspector, and superintendent for various engineering companies to designing, contracting, and consulting work, the latter for 25 years.

He has been Engineer Officer of the Ohio Naval Militia, secretary of various engineering societies, and a member of the A.S.M.E., Cornell Society of Engineers, Society of Naval Architects, and Marine Engineers.

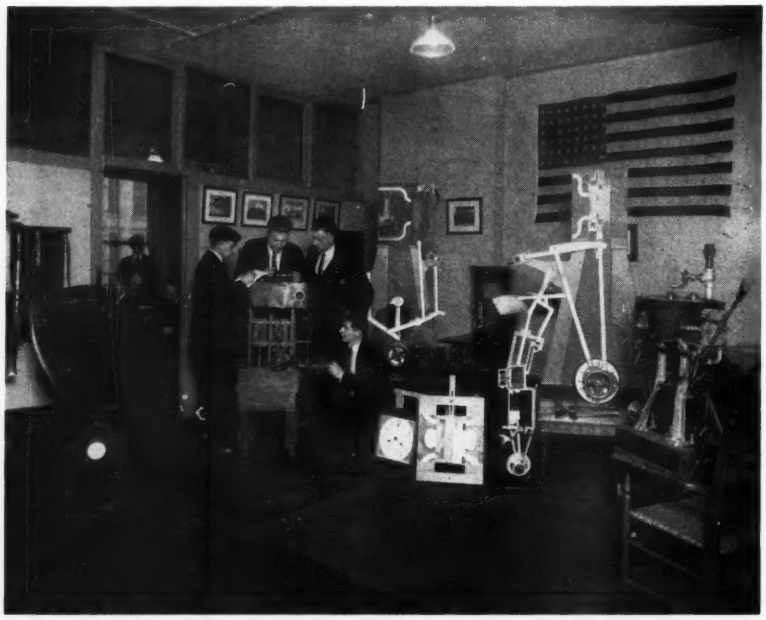
For over 25 years Mr. Gaehr has been instructor in charge of Lake Carriers' Association Engineering School in Cleveland.

light", since the announcement that it is to be scrapped, in spite of vehement protest on grounds of sentimentality and historic values.

A few excerpts from this inspiring address may wet the appetite for more contributions in this intriguing field, from the pen of as yet undiscovered Sibley Alumni authors.

Mr. Dickie uniquely pointed out that for his purpose, parallelism between man and ship is limited to the chief characteristics of a first class man and a first class "man-of-war" (battleship), specifically the U.S.S. Oregon, dividing the subject into the two following sections: (a) the qualities inherent to the design of a battleship, i.e. qualities which cannot be altered, except as they may be modified by acquired features due to her equipment, corresponding to a group of characteristics in the man with which he was born, but which can be changed somewhat by education and experience; (b) an enumeration of fighting and endurance qualities given a battleship by her propelling power (limiting her radius of action), how long this source of power will hold out, her means of offense and defense and the personnel of her complement vs. the analogous fitness of a man due to his will, industry, training, sense of right, and faithfulness to duty.

He points out that a naval architect, in beginning his design of a ship, must decide on the "foundation," called "displacement", as required by the size and weight of the ship being planned, using as a unit 35 cu. ft., i.e. the volume of one long ton of seawater. It may be of interest to note that during the Columbian World's Fair Exhibition in Chicago in 1893, a full-sized model of the Oregon was shown, built of brick and mortar, on a "foundation" of piles and concrete. While instructive in some ways, it constituted a delusion, as it was without provisions to withstand the stresses of turbulent seas.



Models used for teaching in a practical way.

Mr. Dickie brings out the lessons of comparison in "box coefficient", meta-concentric distance (above the center of gravity) as affecting stability and, hence, righting moment. He clinches this particular phase of the comparison by the wise deduction "Instead of rolling gently to irresistible waves that beset him, and swinging gracefully back again into upright position, when the wave has spent its force, he (the Man or the Ship) gathers all the power of his stability to fight against the natural forces around him, shipping huge seas in his desperate efforts to maintain his upright position.

Touching on the "battery" (ordnance) and armor protecting it, he says: "It is all devised by the designer to protect the honor of Our Flag that waves so proudly above it and stands for defense of the right . . . . A man-of-war is a complicated combination of compromises, and so is man. We can carry no more than our displacement (character) represents, and we shall not be able to realize, in action, all that we had planned and sacrificed for, to obtain. But we can carry our battery, that is the mental caliber with which the Great Architect of our being has endowed us, into the battle of life, so that, however the battle may go with us, whether it be victory or defeat, it shall not be disgrace."

Men of Cornell

Cornell, specifically Sibley College, owes much to men trained in designing and operating ships, seasoning their education and progress as no other experience can do.

Dr. Robert H. Thurston, who reorganized this college from the "Mechanical Arts" standard, under Professors Sweet and Morris, to a technical school of first rank, was an engineer officer of the Navy during the Civil War, and later he served on the faculty at Annapolis. Dr. William F. Durand, one time secretary of the College and Principal of the School of Naval Architecture and Marine Engineering, is an Annapolis graduate and has had experience as engineering officer at sea. Though retired from the professorship of Mechanical Engineering at Leland Stanford University, Dr. Durand is now doing important war work at Washington.

In the early days of technical schools, the Navy frequently loaned officers to fill places on the faculties. Sibley had several of these in the early nineties, including Commander Conelly and Captain Walter M. McFarland. "In our time," (beg pardon, Rym Berry) we had George H. Shepherd, M.M.E. '02, an Annapolis graduate of commander's rank, as instructor in "Steam Engine."

In the nineties, quite a few Sibley

graduates entered the U. S. Revenue Cutter Service, amongst them Charles A. McAllister, M.E. '87, who attained the title and position of Engineer-in-Chief, with captain rank. To him is given credit for bringing out the more modern types of cutters around 1920, and he was affectionately called the "father" of the "new" Coast Guard. It should be of special interest to all Cornellians that the present incumbent of the lofty position of Engineer-in-Chief of our famous Coast Guard is Harvey F. Johnson, M.E. '06, with the rank of Rear Admiral.

Other Sibley graduates became prominent in Ship Building, as for instance, the late Trustee Wiley Wakeman, M.E. '99, Vice President in charge of the Bethlehem Steel Company's subsidiary shipbuilding interests; F. P. Palen, M.E. '94, Vice President of one of the shipbuilding companies; Chas. C. West, M.E. '00, President of the Manitowoc Shipbuilding Co.; Eads Johnson, M.E. '99, Consulting Naval Architect and Port Authority.

Prominently identified with the former U. S. Steamboat Inspection Service—later, after a merger of two Bureaus, called the Bureau of Marine Inspection and Navigation —was Joseph B. Weaver, M.E. '02, as director of this bureau and chiefly responsible for the revising of its Rules and Regulations, particularly welding standards.

There are also Cornell men identified with the building of river steamers and some became prominent at the "operating" end, like Carl J. Jeffries, M.E. '10, formerly with the Shipping Board as fuel expert; now Chief of Scientific Section with Gibbs & Cox, Inc. (Naval Architects). Also A. E. Smith, B.S. '16, who "sailed the seven seas", as a Chief Engineer, now special engineer with the Socony-Vacuum Oil Company.

Any one of these men could furnish most instructive material to keep the CORNELL ENGINEER properly "web-footed" and on "sea-legs", as should be the case, true to the early history of Sibley College and Cornell's reputation as "sweeping the waters" with its crews.

Considering the splendid work done by Dr. Durand and by the fine men introduced by him to maritime interests, the writer has always felt and urged that there should be a Navy contingent connected with Cornell, comparable to the R.O.T.C.

Classification of Ships

A volume could be written on "Men and Ships" as contrasted from the viewpoint of an operating engineer.

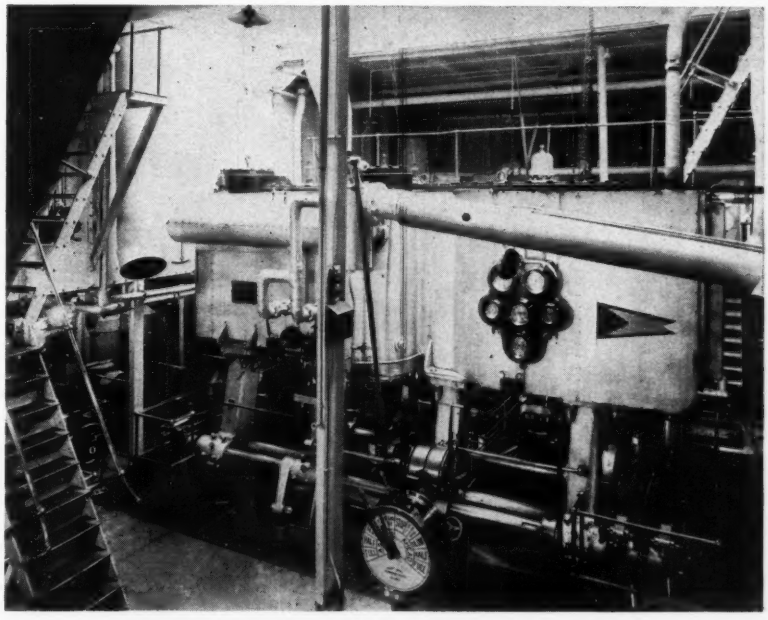
In such an analysis, first the types of ships would be considered. They are classified usually according to purpose, "run", size and means of propulsion, all the way from the graceful, speedy and luxurious "liner", or busy freighter, or ice breaker, or tug, down to the mud scow or dinghey or punt. Naval craft would range from the "battle wagon", or hospital ship, or cruiser, or repair ship, or collier, down to barges, or floats. Each has a close counterpart in the "race of men" with corresponding characteristics.

Depending on business conditions, and the season, the mental attitude of the lower ranks of sailors is either one of willing servility (when the "dough" is gone and he has "wrinkles in his tummy," and you can talk to him), or one of abject independence (when there is still coin tinkling in his pockets, at which time he is as apt as not to tell a shipping agent soliciting his services to "bring her around and let me look at her"). The personnel of officer grade, for the most part, however, consists of a fine lot of worthy American gentlemen —thrifty, diligent, conscientious and capable.

Here are just a few "pointers" to start the reader in finding his own maritime "incarnation" in that formidable array of ships, and starting a beneficial self-examination:

(1) The movements of none of these "floating bodies" are under control, without "steerage way", due to power applied from within or without, suffcient to counteract resistance, wind (though that might be the driving force), current or tide. A fruitful field of reflection as to "motivating" impulses, ideals, and sources of "inner strength", is here offered. Power plants are replete in food for comparative thinking. For instance, a prime mover operates at greatest efficiency when loaded to capacity. Over or under capacity, the efficiency drops off.

(2) Without proper ballast,



Engine in operation on a Great Lakes freighter.

hence "draft", a vessel bobs up and down on the waves, the smaller, the worse.

(3) Referring to Mr. Dickie's disseratation on stability, the operating crew would know enough not to hold a ship strictly on its course, if thereby unduly strained by wind and sea, but the wheelsman would obey the order to "ease her a bit", while still following, in general, the desired direction. Another example of this principle might be cited in one of the first efforts of turbine application to a torpedo boat, with its characteristically light hull construction, though satisfactory for the former reciprocation engine drive. The gyroscopic effect on the turbine, (acting like a "stabilizer", not then understood), rendered the ship the equivalent of a floating break-wall for which it had insufficient strength and, hence broke in two.

"Once A Sailor, Always A Sailor"

The types of men operating ships form an interesting study.

"Once a sailor, always a sailor"; they are responding to "the call of the Sea." Though cursing the hardships and handicaps of seafaring life, they would not change their lot by choice, but often do change it by pressure of family circumstances. The "deep sea sailor" (salt water man) is apt to look down on the men manning our Great Lakes and River vessels, calling them "dish pan sailors." However, the fact remains that the traffic on these waterways is astounding, though little appreciated by the average American, and, on the whole, the ships' personnel is of higher grade than that of their "ocean-going" brethren.

The salt water man frequently brags that he is afraid of nothing, when he is on a staunch vessel with plenty of water under him and around him.

The fresh water man, however, has to sail much of the time on rivers, through channels, locks, near shoals, in spite of storms, fog and darkness, as well as on connected lakes, which can become so treacherous and rough as to scare an "ocean man" stiff, by honest confession of such men.

The name of *Cornell* has travelled up and down the Lakes (a distance of about 1000 miles from Buffalo to Duluth) for around forty years on one of the bulk freighters in the "college boat" class, owned by The Pittsburgh Steamship Company, and is still giving a good account of itself. She is of about 4500 tons, about 460 feet long, with a 50 foot beam, and powered by quadruple expansion engine to give a speed of about 12 miles per hour loaded, and 13 or 14 miles per hour light.

The skipper of the *Cornell,* Capt. John C. Murray, just "brought out" the Irving T. Olds, the last of 5 sister ships of most modern type, being of 10,500 gross tons, 640 feet long, 67 foot beam and driven by a cross-compound, double reduction gear, Westinghouse turbine. Of course the latest refinements as to stokers, stage feed water heating, motor-driven auxiliaries, etc., are included, to do justice to which, in a good "engineering report", would demand the space of a series of articles.

The executives and personnel of such Steamship Companies are in a class by themselves,—as keen, able, aggressive, and resourceful as those of any steamship companies anywhere, American or foreign. Mr. A. H. Ferbert, the President; H. S. Strom, the Vice President; D. C. Potts, the Traffic Manager; Capt. R. M. Crawford, the Fleet Captain; J. F. Wood, the Fleet Engineer and Captain W. F. Meister, Construction Superintendent are living examples of effective cooperation, approachableness, and leadership, as they head the largest fleet on the lakes.

New Types Of Ships

A very interesting type of ship is the "self-unloader", some of which have turbo-electric drives, like the Steamer Robinson and Steamer Bradley Transportation Company. Some of the car-ferries also are most modern. Not to speak in detail of tankers, sand-suckers, package freighters, some of the palatial passenger steamers, several of which have been and are being converted into plane carriers for the Navy, should receive attention, but space does not permit.

A great percentage of the vessels on the Great Lakes, almost exclusively bulk freighters, are on the roster of the Lake Carriers Association — an organization in which vessel owners pool their interests, commercial, legislative, and labor. One of the association's activities is the welfare plan, inducing men to become thrifty and helping them through a savings plan by issuing safety information and by organizing an educational program with which it has been the writers privilege to be identified for over a quarter of a century, as, instructor in charge of the Cleveland Engineer's School. The association also conducts schools in other cities.

Unique Schooling

The curriculum, the kind of students, and approach in this work are truly unique. The main problem is how to quickly impart the fundamentals of engineering, electricity, and refrigeration, in sufficient quantity to enable these youngsters to intelligently operate the usual electrical and refrigerating equipment commonly found aboard these ships. In the time between finishing "laying up" and "fitting out" 50 to 100 men must be schooled in this training. There are no entrance requirements, except that the candidate must be vouched for by his captain and chief engineer as having served the requisite time and as being desirable material for an officer's berth.

Naturally such men learn much more readily by seeing things and having them explained by an enthusiastic, sympathetic, but forceful instructor, than by reading books. Yet they must learn to study. It is not a question of giving lesson assignments or lecture courses, and then passing or flunking a man upon his examination. It is, rather, an unparalleled task of pounding in the essential knowledge as thoroughly and as rapidly as possible. Other kindred subjects are touched upon such as engineering materials, mathematics, physics, and chemistry to enable the student to handle the more common types of marine engineering problems. Throughout it all an effort is made to orient and inspire the student in the ways of sea life. Such is the preparatory training which this school gladly assumes, though it be a secondary role in the education of seamanship.

NEWS OF THE COLLEGE

President's Report

In his annual report for the academic year, 1941-42, President Day reports that the Engineering, Science, and Management War Training courses supported by the U. S. Office of Education and conducted by the College of Engineering enrolled more than 7,000 men and women, including employees of more than 450 industries, in 18 training centers in up-state New York. Included were courses in ordnance materiel inspection and electrical communications for the U. S. Army and Diesel engine instruction for the Navy. The Diesel engine course became the nucleus for the Naval Training School established on the campus July 1, with a quota of approximately 950 student officers in the U. S. Naval Reserve. A new mess hall has been completed for the school, and a Diesel engine laboratory is under construction.

In the ROTC, 1,055 men completed the first year of training, 806 the second year, 202 the third year, and 203 the fourth year—the latter receiving commissions as second lieutenants in the Army. Enlistment of undergraduates was responsible in part for a second-term decrease of about ten per cent in enrollment, twice the usual figure. Several hundred male undergraduates enrolled in officer-training programs offered by the Army, Navy, Marine Corps, and Coast Guard.

Donations during the year included $585,000 from Franklin W. Olin through the Olin Foundation toward Olin Hall of Chemical Engineering; an addition of $275,085 to the John McMullen Scholarship Fund in the College of Engineering from the John C. McMullen estate; $75,000 from the Rockefeller Foundation for several projects; and $71,600 from S. C. Johnson and Son, Inc. toward the Herbert Fisk Johnson Professorship of Industrial Chemistry. Total gifts for the year, $2,041,513, were slightly below those of 1940-41 but were above the average for the last 20 years.

ASME Convention

On October 14, with Prof. Ellenwood in charge, a group of 44 ME's left to attend the ASME Convention at Rochester, N. Y. One of the first things they did was to attend a luncheon at the Sagamore Hotel that day where Roland B. Woodward, a Regent of the State of New York, gave the talk "Engineering as a Profession."

The highlight of the convention for our ME's was the trip through the Kodak Park Works. The group went through the refrigeration plant, largest in the world and having a capacity of 16,000 tons per day. This plant handles the job of keeping the atmospheric conditions in the works constant as the film is processed. The refrigeration system consists of ammonia compressors, some of which have been in continual operation for thirty or forty years.

Appointment

President Day recently announced the appointment of Dr. Eric T. B. Gross as assistant professor in the School of Electrical Engineering. Dr. Gross, who has been at City College of New York as an electrical engineering instructor since January 1941, was previously at Cornell in the capacity of visiting doctor and Westinghouse research associate.

Before coming to this country, Dr. Gross lectured at the Institute of Technology, in Vienna, from which he had formerly graduated with highest honors. He was also head of the engineering division of the Central Station Department of the Union Electric and Manufacturing Company in Vienna. Dr. Gross is recognized as one of the leading European authorities on protective devices in high transmission networks, and holds several patents on his developments.

At the same time, the following appointments were also announced. Kenneth Rose was appointed as an instructor in metallurgical engineering in addition to his duties as administrative assistant to the E.S.M.W.T. program. Dr. George Winter, former research associate instructor is now an assistant professor in the Civil Engineering School. The following instructors were given positions in the School of Mechanical Engineering: in mechanics, Herman A. Lang; in machine design, Gerard H. Northmann; in engineering drawing, Edgar R. Watt; and in engineering materials, Andrew P. Boehmer and Charles R. Otto. Marvin Bogema received a promotion from mechanics instructor in the Sibley School of Mechanical Engineering to assistant professor of hydraulics in the Civil Engineering school. George E. Stewart was appointed assistant to the director of the Sibley School of Mechanical Engineering, and Lawrence B. Spencer was named instructor in electrical engineering.

Cooperation Program

In order to open new opportunities for students in Arts and Sciences and other non-technical colleges, the College of Engineering has announced a list of 18 courses which Arts students preparing for military service may elect, usually without any prerequisites in engineering. These include industrial organization and management, industrial relations, personnel management in industry, principles of industrial accounting and cost finding, motion and time study, drawing and descriptive geometry, mechanical drafting, heat-power equipment, metal working, casting processes, machine tool processes, measuring instruments, and materials of engineering. It is especially hoped, according to Dean S. C. Hollister, that women students, who in the future will find wide opportunities for service in war industry, will take advantage of these courses. Other subjects may be added if sufficient demand is indicated.

Dean

Dean Wheeler, EE

IT IS the all-around fellow, not the "greasy grind," who comes out on top in college. At least that's the idea one gets from considering Dean Wheeler, number one senior in the EE School. This recipient of four scholarships and numerous scholastic prizes and honors still manages to sandwich in time for sports, societies, fraternity activities and his hobbies, which include, among other things, making frames for the Petty pictures which hang in his room.

A three-letter man in high school, Dean went out for freshman baseball and track, and has also represented his fraternity, Alpha Sigma Phi, in interfraternity softball. He is house manager of his fraternity, and has been chosen president of the Student Engineering Council, of which he was secretary last year. He is a member of Tau Beta Pi, Eta Kappa Nu, AIEE, and the Delta Club.

Dean has always had a liking for engineering. While still in high school in Hancock, N. Y., he made himself a stroboscope, model airplanes, a sextant, and even a transit with which he laid out a football field.

During the summers which followed his freshman and sophomore years, he worked for his uncle, a plumber. "Everything from plumbing to painting barn roofs," is the way Dean describes his activities, but he names as the most interesting adventure installing the plumbing for a girls camp.

Dean spent last summer in Schenectady as a student engineer for the General Electric Company. Specializing in development of marine and aeronautic equipment, he was also sent to Fort Monroe for three weeks. He must have liked the work, since he plans to return to G.E., if possible, after his graduation in June.

His popularity, helpfulness and good humor combined with his 92.08 average show that Dean has a fine chance of fulfilling his ambition—"To be a good engineer."

Tom O. Nobis, CE

IT WAS with some hesitancy that Tom Nobis decided to leave his native mid-west to enter Cornell four years ago. Tom had long ago elected engineering as his profession, but the choice of a college was still a problem. After a tour of the East, though, during which he met Dean Hollister and several of the members of our faculty, Cornell seemed to him pretty tempting bait. Accepting a McMullen Regional Scholarship, he came into the School of Electrical Engineering, with the idea of specializing in television. But somehow, the magic of electricity failed to hold his enthusiasm, so he deserted these mysterious realms for another field. At the end of his freshman year, he entered the School of Civil Engineering and soon found his place.

His last few summers have been spent for the most part working in various construction firms. In one rigorous season of manual labor he participated in the paint-swashing of Iowa's largest barn. The next summer found him with the Central Engineering Company of Mississippi as an engineer. Building dams and working on roads was then the order of the day. But his administrative option at school helped him to qualify this last summer for a white-collar job in the central planning department of the Rock Island Arsenal. Here many of the problems of purchasing and cost evaluation were placed in his hands. A good bit of his time was spent with an industrial investigating committee recommending Navy Excellance Pennant awards.

As president of the Beta house, he serves one of his many well deserved positions with the same earnest, good-natured spirit that has won him so much popularity on the Hill. With keen enthusiasm for athletics, he has participated in wrestling and 150 pound crew, winning numerals and varsity letters in both these sports. In military and scholarship he has likewise tasted succes. An affiliate of Scabbard and Blade, a McMullen scholar, with three years on the Dean's list, a member of Chi Epsilon, of which he is vice-president, and a member of Tau Beta Pi, of which he is also vice-president, Tom has made good use of his four years' stay here at Cornell. Other of his affiliations include Red Key, Sphinx Head, of which he is treasurer, Student Engineer's Council, and the Intrafraternity Council.

Tom

William H. Sens, ME

BILL Sens seems not to have received the engineering idea from divine inspiration or parental urge, but from cold, logical deduction of facts. With a natural gift for mathematics and the physical sciences, he quickly perceived the right path and through loyal alumni was rescued from the very gates of Lehigh University and safely settled on the Hill.

In the Sibley School of Mechanical Engineering he found his mark making admirable scholastic records. The first year, besides having maintained the highest average in the class, he found time to participate in wrestling, subsequently winning his numerals in the sport. Plunging ahead into the second year with undiminished academic fervor, he was again rewarded for his well earned achievements by Atmos, a mechanical engineering honorary society. Cited as the most outstanding member of his class, he was awarded the Sophomore Book Prize. Never failing in his interest in athletics, he entered the 150 pound football tryouts and made the team. His junior year was starred by another honorary award, the first prize of the Sibley School of Mechanical Engineering for the highest average of both juniors and seniors in mechanical or electrical engineering. Great would be the embarrassment now for the kindergarten teacher who had kept him back a year because he could not pile blocks up right.

Most of his college summers were spent in the Bell Telephone Company of New Jersey where he served in an engineering capacity. This last summer, however, saw him here, like many of us, beladen with books and slide rule. During odd hours he worked in Director Barnard's office. This fall, he was appointed an assistant in the mechanical laboratory handling the reams of examination papers and reports which have to be corrected.

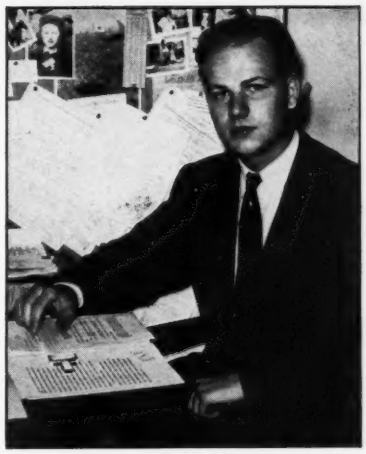
Additional recognition of his scholastic attainments is evidenced by his holding membership in Atmos, and the much coveted Tau Beta Pi. He is also one of the few to hold two scholarship at once—a McMullen Regional and a McMullen Undergraduate. Despite his numerous jobs around school, Bill still finds time to serve on the engineering council as an outstanding scholar and friend to his class.

Bill

John A. Newman, ChemE

DUE to a disconcerting mixup with another John A. Newman, John nearly missed being registered in the School of Chemical Engineering at Cornell; but things straightened out soon and by the end of the first term "Baldy", as he is known to his classmates, was making rapid progress. He was on the Dean's List the first term, and since then has never been off it. Because of his good record, he was awarded a McMullen Scholarship in his Junior year.

John was born in Cleveland, Ohio, more than twenty-one years ago. For preparatory training, he went to the University School in Cleveland, immediately after which he came to Cornell following his father, who was graduated in 1912 with a B.A. in Chemistry.



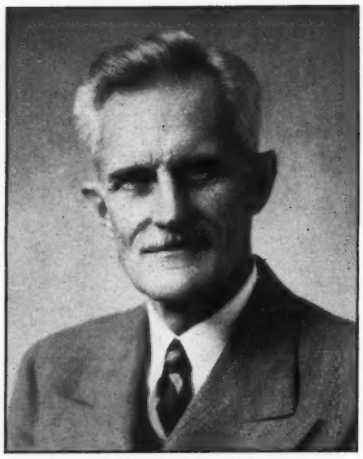
Baldy

A goalie in Frosh hockey, he switched sports in his Sophomore year and went out for Crew Manager's competition. At the present time he is the Manager of the Frosh Crew, with still another year to go. He is a member of Sphinx Head and Red Key, Senior and Junior Honorary Societies, and also of Majura. He is also prominent in his own school, being treasurer of the A.I. Chem.E., vice-president of Retort and Beaker, and a member of Aldjebar. John joined the "Deke" house in his Freshman year and is now its president. John is taking the Administrative Option in Chemical Engineering and was planning to go into the petroleum industry after graduation. But in view of the present crisis, he feels that he should enlist with the Air Corps Engineers.

In line with his ambition, John has spent his summers wisely. He worked as a "roughneck" in the oil fields of southern Illinois for two summers; last summer he was in the technical service department of the Standard Oil Company of Ohio. A lover of travel, John once worked on a tanker which traveled the Gulf of Mexico and the Atlantic Coast.

John, reliable and capable at Cornell, is certain to be successful at whatever job he tackles, whether in the Army or in the oil industry.

THE ALUMNI



W. M. Hepburn, M.E. '11

Hepburn Wins High Honor

THE highest honor within the gift of the American Gas Association was conferred recently on W. M. Hepburn, M.E.'11, vice-president of Surface Combustion, Toledo, Ohio. Mr. Hepburn received the Chas. A. Munroe Award at the Association's annual meeting in Chicago for having made the most outstanding recent contribution toward the advancement of the gas industry. Consisting of a substantial financial acknowledgement and enbossed certificate, the Award was made to Mr. Hepburn for his outstanding achievement in translating gas service in industrial utilization equipment.

Among the developments which have come under Mr. Hepburn's direction and bear the imprint of his ingenuity and sound engineering ability are diffusion combustion, continuous gas carburizers, DX gas atmosphere, gas preparation machines, walking beam and a wide variety of material handling mechanisms on furnaces of the walking beam type, one-way soaking pits, normalizing for full finished automobile sheets for deep drawing, bright annealing of both ferrous and non-ferrous metals, radiant tubes and convection furnaces.

Mr. Hepburn graduated from Cornell University in 1911 with a degree of Mechanical Engineering.

Carpenter Speaks Of Wartime Needs

INITIATIVE and daring are held wartime needs by Walter S. Carpenter, Jr., M.E. '10, president of E. I. DuPont de Nemours and Co. of Wilmington, Delaware.

"Vision and daring can surmount any difficulties that may arise on the war or home front," he said in a special issue of *"The DuPont Magazine"*, commemorating the company's 140th anniversary.

Carpenter stated that "the momentum of America will not be stopped," and declared that he felt "there is nothing awaiting us of America, either in business or on the nation's battle lines, that we cannot overcome with fundamental study, effort, initiative, vision and daring."

Explosion Shakes Plant Of I. S. Boak, M.E. '14

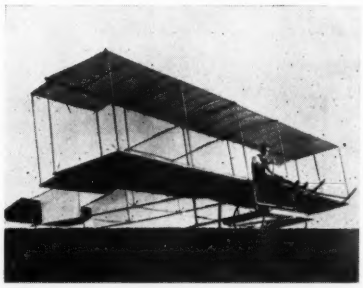
A POWERFUL midnight explosion shook the huge plant of the Winchester Repeating Arms Co. Plant manager, Thomas I. S. Boak, M.E. '14, terming the explosion "accidental", said it occurred in a small sheet metal building when a worker dropped a tray containing explosives. Fourteen of the fifteen persons in the building were injured. The building's roof, not attached to the walls, was blown to bits, and windows throughout the factory were shattered, although no machinery was destroyed. Boak, a trustee of the University, estimated damage to the new building to be $10,000.

R. H. Depew, Jr., M.E. '13

THIRTY-ONE years a licensed pilot, Richard H. Depew, Jr., '13, executive vice-president of the Taylorcraft company, flew a production glider off the assembly line to an Army flying field; the tow-plane was an Army Stearman. In doing this, Mr. Depew kept up his unbroken record of having personally delivered the first production jobs on the various Army contracts awarded the company. He personally delivered the first YO-57, the first 0-57, and now the first Taylorcraft Army glider.

In taking over the controls of the TG-6, Dick Depew renewed an acquaintance with glider piloting that began back in 1911. Early that year he and fellow members of the Cornell Aero Club, one of the first college flying clubs ever organized, built and flew a glider of their own design. The *Cornell* glider, a flimsy-looking affair, was a mass of "sticks and wire" that flew ten to twenty feet off the ground over distances of a hundred and fifty feet. It was lifted onto a dolly using bicycle wheels which was pulled downhill by a number of boys running at top speed. It took off when it was ready, or when sufficient flying speed had been attained, leaving the dolly to run freely and knock over the least nimble of the boys on the other end of the tow rope.

"Cornell" Glider of 1911



Use The Cornell University Placement Bureau

WILLARD STRAIGHT HALL — H. H. WILLIAMS, '25 Director

Before you call Long Distance, please ask yourself:

1. *Is it really necessary?* 2. *Will it interfere with war calls?*

TELEPHONE lines—especially Long Distance circuits—are crowded as never before, these war days. Materials to build new lines—copper, rubber, nickel—are needed for the shooting war. So we must get the most out of present facilities.

You can help us keep the wires clear for vital war calls if you will do these two things: (1) Don't call Long Distance unless it's urgent; (2) Call by number if possible and please be brief. Thank you!

WAR CALLS COME FIRST!

CORNELL SOCIETY of ENGINEERS

107 EAST 48TH STREET NEW YORK, N. Y.

GEORGE N. BROWN, *President*
55 Liberty St., New York, N. Y.

JAMES LYNAH, *Executive Vice-President*
Brunswick, Ga.

PAUL O. REYNEAU, *Secretary-Treasurer and Placement Director*
107 East 48th St., New York, N. Y.

DAVID HARMON, *Recording Secretary*
380 Pearl St., Brooklyn, N. Y.

FURMAN SOUTH, JR., *Vice-President*
1140 Wightman St., Pittsburgh, Pa.

CARLYLE M. ASHLEY, *Vice-President*
207 Brattle Road, Syracuse, N. Y.

EZRA H. DAY, *Vice-President*
1081 Broad St. Sta. Bldg., Philadelphia, Pa.

WILLIAM H. HILL, *Vice-President*
501 Klag Ave., Trenton, N. J.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

Fellow Cornellians:

The importance of Alumni Placement has long been recognized by the Society. Several years ago a budget appropriation of approximately ten percent of our income was made by the Society as a contribution to that work and since that time, regularly every year, financial assistance of this same amount has been given. As usual this has been allocated to the office in New York City because it seemed to your Executive Committee that this office was where financial help was most needed. Alumni Placement is centered in the University Placement Bureau at Ithaca, N. Y. where senior interviews, place ment and student vocational guidance are handled. In addition to the full time office in New York City, there are in many cities volunteer placement representatives who clear through the Ithaca office. Judging from many comments received from Cornell engineers and outsiders who have come in contact with the work, we can well be proud of the effectiveness of the service, and know that our appropriation has been used to good advantage.

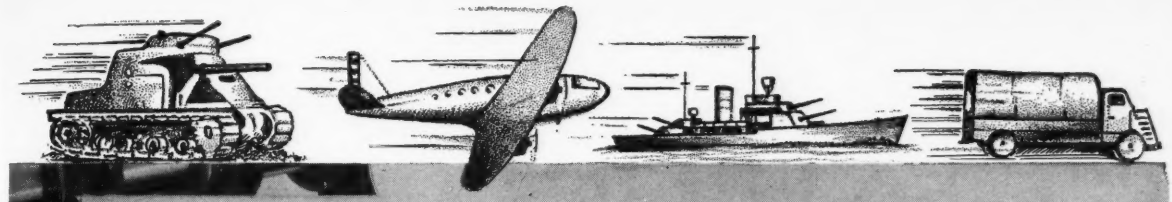
Your Executive Committee, however, is well aware that the fine results of the placement offices have been obtained in spite of difficulties which have threatened the continuance of the work.

The Committee feels that the financial support given to the placement of alumni has been far too small and that proper facilities and means must be provided to insure permanence, continuity, and increasing effectiveness of the service. With this in mind, your Executive Committee passed a resolution at its last meeting for me to present to the Convention of the Alumni Association in New York City on October 30 and 31 next. In substance the resolution requests that the Alumni Association take the necessary steps immediately to remedy the present condition and to establish Alumni Placement on a sound and permanent basis. This request is in accordance with the plans adopted two or three years ago when Cornell Alumni affairs were reorganized under the new name of Cornell Alumni Association. Seeing to it that Alumni Placement was adequately implemented was then established as a function of that organization. I trust that by the time you receive this magazine the requested action will have been taken and that means will have been found to insure the continuance of the work during these trying times.

Experience has shown that the service of Alumni Placement is equally important under varying economic conditions and now during war time is no exception. The work takes on different aspects as times change. Ten years ago finding jobs for unemployed and helping men to build up self-confidence during financial adversity may have been the principal function carried out. Today much of the work is finding qualified men for special work with the armed forces and government agencies. Handling many cases of occupational changes brought about by our war economy, is also an important duty of these Bureaus. Finding the right man for any of the war organizations is of definite assistance to the war effort. Looking ahead to the coming of peace, the problem of relocating the many Cornellians discharged from the Service will predominate. The many valuable contacts established and maintained by the continuing activity of the Bureaus will be of immeasurable value in this work. Underlying all the functions and probably more important than any are guidance, counsel, and consultation, the demand for which is always present under all circumstances. There is a time, often several times in any man's career, when he needs to discuss his vocational or employment problems, to evaluate his assets and plan the best use of them. This service can best and most understandingly be furnished by his own University as a continuation of the education he received there. It will be received with gratitude and will not only assist him in making a success of his work but will increase the bonds between him and his Alma Mater. Obviously consultation requires for its full effectiveness personal interviews. This emphasizes the importance of the New York office, which is within easy reach of the largest body of Cornell Alumni and located in the city that many Cornellians visit on business trips.

Yours sincerely,

G. N. BROWN, Pres.



KEEP PRODUCTION ROLLING with MORSE ROLLER CHAINS

These great power transmitters pass along *all* the power of drivers to production machinery. No slips, no wasted power—Morse Roller "Channel-Lubricated" Chain drives deliver power with constant efficiency. They're rugged, long-lived, reliable. Worries about frequent maintenance or repair shutdowns end with the installation of Morse drives.

On many machines, in many plants, the change to Morse Roller Chain drives has boosted production to new highs, set new records for sustained productivity. First cost is low — maintenance costs are lower, due to the exclusive long-life features not available on less satisfactory drives!

Regardless of your chain requirements there is a Morse Roller to meet them, efficiently, economically. All sizes and capacities, single and multiple widths.

Call the Morse man. He'll help you look for places for profitable use of Morse Roller Chain Drives.

Oil gets in—
Wear stays out!
Heart of the Morse Roller Chain is protected with a life-preserving film of oil, flowing there through channels from the bushings. Oil gets in—wear stays out!

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

SAVE TIME WITH THESE
HANDY LUFKIN TAPE-RULES

Every busy engineering student needs a Tape-Rule for his vest pocket — where it's handy and ready for those dozens of little measuring jobs that come up every day. There's no need wasting time in search of a tape or in trying to guess the measurement. Just reach in your pocket for your "Mezurall" or "Wizard." Your dealer can help you select the one you need.
MEZURALL
WIZARD
JUNIOR
LUFKIN

NEW YORK
106 Lafayette St
THE LUFKIN RULE CO.
SAGINAW, MICHIGAN
Canadian Factory
WINDSOR, ONT.

TAPES — RULES — PRECISION TOOLS

Cascadilla School
Est. 1870

A preparatory course aimed at making students really ready for Cornell.

Special attention to students with unusual programs or to whom English is a foreign language.

University Tutoring

Tutoring in university courses that is effective because directed to individual needs.

Inquire about Cascadilla

DIAL 2014 ITHACA, NEW YORK
C. M. DOYLE '02, *Headmaster*

LAVA

Manufacturers of
Super-Refractories Only

•

GRAPHITE CRUCIBLES
REFRACTORY CRUCIBLES
HIGH-TEMPERATURE CEMENTS
SPECIAL REFRACTORY
BRICK, TILE, SHAPES

•

From the Following Materials:—
Graphite, Silicon Carbide, Fused Alumina, Mullite, Magnesia, Zircon.

•

LAVA CRUCIBLE COMPANY of PITTSBURGH
Pittsburgh

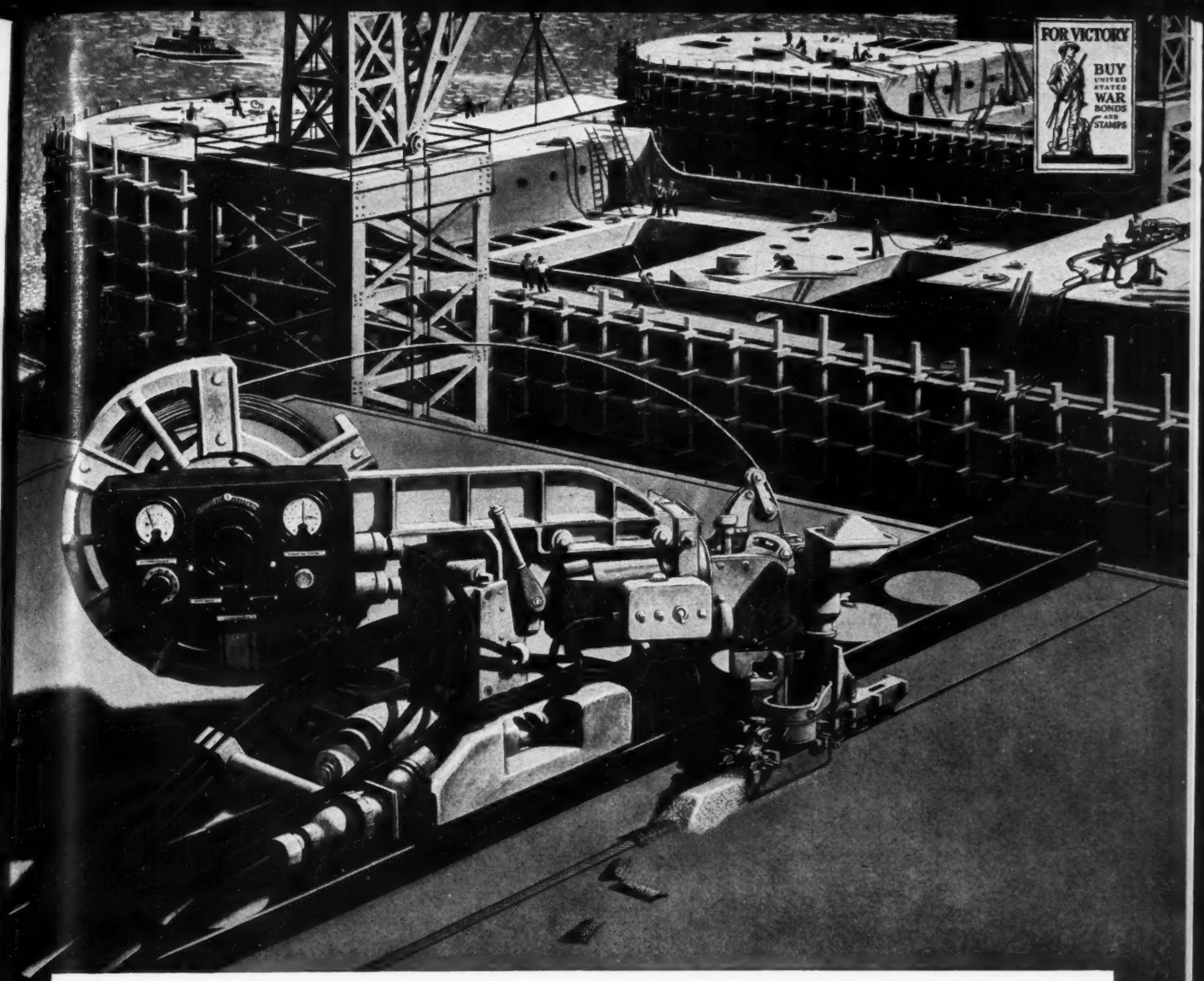
When you think of

Printing

Think of

Nortons

OPPOSITE THE STRAND THEATRE



MAKING ONE-PIECE SUITS FOR *SHIPS!*

THERE'S NEWS on America's ship ways today . . . an amazing machine that unites steel plates without noise, fuss, sparks or visible arc! A process that is helping to construct those marvels of speed, strength, safety, and carrying capacity . . . "all-welded" ships!

This process . . . known as "Unionmelt" Welding . . . joins steel plates of any commercial thickness as much as 20 *times faster* than any other similarly applicable method! And it produces uniformly high-quality welds!

How does it work? A special welding composition . . . "Unionmelt" . . . flows from a hopper and blankets the edges to be joined. Within this granulated mixture, intense concentrated heat is generated by electric current. A bare metal electrode and the edges being welded are melted and fused. Some of the "Unionmelt" melts and remains as a temporary protective coating over the weld.

The process is completely automatic. Special apparatus feeds the "Unionmelt," the welding rod, and the electric current. Speed and current values are adjusted by an operator.

"Unionmelt" welding is also speeding up the construction of fighting tanks and chemical tanks . . . artillery mounts and aircraft parts . . . pressure vessels and locomotive boilers . . . pipe and pipe lines . . . and all kinds of heavy mechanical equipment.

Working with this unique process is an astoundingly fast Linde method of preparing steel plates for welding. White-hot oxy-acetylene flames . . . cutting simultaneously at different angles . . . bevel and square-up steel plates as fast as they are needed! Together, these two processes are speeding up the fabrication of key equipment at a remarkable rate.

Many years of research into welding, flame-cutting, flame-fabricating, and flame-conditioning of metals have given Linde engineers a vast store of useful knowledge about these methods. Have you a war production problem which might be solved by this "know how"?

The important advances in the cutting, conditioning and fabrication of metals made by The Linde Air Products Company have been facilitated by collaboration with Union Carbide and Carbon Research Laboratories, Inc., and by the metallurgical experience of Electro Metallurgical Company—which companies also are Units of Union Carbide and Carbon Corporation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

GENERAL OFFICES: New York, N. Y. **Offices in Principal Cities**

Imagineering

(Continued from page 5)

of heavy equipment. They also had vision.

The entire West Coast shipbuilding area, from Portland to Wilmington, is characterized by intense competition between yards, and in the yards between various departments and shipways. Suggestion systems are in full use, with War Bonds and other prizes going to workers who turn in ideas which improve production, methods, or safety. The yards at present are geared to a schedule of a ship per way per month, but in point of fact this could be bettered by far were it not for the acute shortage of materials. Morale is excellent; said one worker, "We know there's a war on here. We've been shelled."

We read daily of the spectacular successes our heavy bombardment aircraft are enjoying in the skies of Europe and the Pacific. Behind these, too, is the imagineer. In the aircraft industry, we find that entire fuselages and airfoils are built in various parts of the country, and are shipped to other places for final assembly. In order to avoid the costly and time-consuming manufacture of templates which would have to be distributed to the various manufacturers of subassemblies, the imagineers have had a book of equations prepared for each aircraft. Thus, it is necessary only to send the equations around, and when design changes are made, these can be reflected by a change in the expressions rather than by making new templates.

In the motion picture, "Wings for the Eagle," one saw the familiar dwarf who crawls inside the fuselage of an aircraft to make control and communications installations. This fellow is excellent human interest, but darn poor production, for the simple reason that the method is too slow. The imagineers have speeded up this operation by halving the fuselage longitudinally, like a loaf of bread cut lengthwise. Each half can be worked on by a number of normal size people simultaneously, and when the installations are complete, the two parts are "buttoned up". New aircraft now on the boards or in development have this feature incorporated into their design.

There has been some inclination on the part of the public to censure the aircraft industry for lack of production. It must be remembered that only three years ago the mass production of airplanes was unheard of in this country. Also, three years ago—and less than that—those who built war-planes were "war-mongers" and "merchants of death". In three short years our aviation industry has achieved mass production, accomplishing what our enemies, with full and complete governmental backing, did in eight.

There are now nearly ready for mass production improved models of our best known heavy bombardment airplanes. The details of these improvements, naturally, are of a secret nature. Suffice it to say that their performance will exceed in every way those now in use by our Air Forces.

Add to the list of those things, both tangible and abstract, which will win the war, the imagineer.

HIGGINS

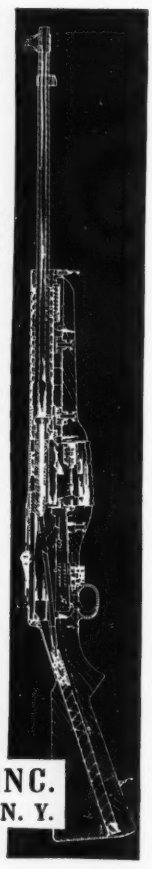
AMERICAN DRAWING INKS

for speed and accuracy

The razor-edged sharpness of line that is characteristic of drawings made with Higgins American India Ink saves time and temper when both are precious. For more than 60 years draftsmen have used Higgins to insure accuracy and permanence for their creative efforts. Use of Higgins Waterproof India Ink means: complete absence of "ghosts," eye-saving visibility, proof against smudging and cleaning with carbon tetrachloride.

The Johnson Semi-Automatic Military Rifle, illustrated by courtesy of Johnson Automatics, Inc.

AVAILABLE IN A COMPLETE COLOR RANGE



HIGGINS INK CO., INC.
271 NINTH ST., BROOKLYN, N. Y.

ON EDDY ST. AT THE GATE

ALWAYS A PLACE TO PARK

SCOTCH

The Store of Good Spirits

East Hill Supply Co.

RYE

ALWAYS A PLACE TO PARK

416 EDDY ST. PHONE 2964

Battle wagons have glass ears . . .

SOMEWHERE on the tough hide of U. S. warships are mounted what look like inverted glass mixing bowls.

These are the radio lead-in insulators, the "ears" through which the battle wagons get their orders. They are made of Pyrex brand electrical glass, as are the insulators in the ships' antenna, because the service requires the best and most dependable materials available.

Today, with metals scarce, the raw materials for glass are fairly plentiful. And glass is being put to work at many urgent tasks. Planes, tanks, ships, trains, for example—all use some contribution of Corning research in glass. The giant dairy industry, faced with a metal piping shortage, is now working with special glass piping recently developed at Corning. In chemical, food, and explosives plants, glass piping and glass pumps are handling everything from soup to HCL.

Years ago glass was regarded as a fragile, decorative, costly material with limited applications. Now Corning makes glassware that has kicked old barriers out the window. It's tough and strong, resistant to chemical attack and thermal shocks, widely varied in shape and size, reasonable in cost, and accurate to tolerances comparing favorably with metals. Today's engineers are discovering that they can put glass to practical uses which in the past were labeled, "impossible". For tomorrow's engineers, glass is the material of unlimited possibilities. Industrial Division, Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass

SMALL TOOLS...

VITAL

TO OUR VAST WAR EFFORT

● Efficient small tools, such as *"Greenfield"* has been manufacturing for more than 70 years, are essential to America's armament program. "G.T.D. Greenfield" Taps, Dies, Twist Drills, Reamers and Gages are helping to build planes and tanks, ships and guns on a thousand "production fronts."

America's great metal working industry has learned by long, practical experience that the "G.T.D. Greenfield" trade mark means utmost reliability and accuracy in these vital tools.

GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASS., U. S. A.

GTD GREENFIELD

TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES

Confidence
Patronage
Satisfaction

We're going to win your Confidence and Patronage with your first order for you will have learned that you can place an order with us and then forget about it, knowing that it will be completed to your entire Satisfaction.

▼

Stover Printing Co.

113-115 South Tioga Street

Right and On Time Since 1909

Defiance Drawing Instruments

A combination set with large, center adjustment pencil compass and extra parts for easy conversion to pen compass or dividers. Also combination ruling and detail pen.

$9.85

Complete in leatherette cases

▼

DEFIANCE DROP BOW COMPASS

$5.00

▼

THE CORNELL CO-OP

Barnes Hall — On The Campus

Couch Liquor Store

Opposite "The Ithaca"

Imported and Domestic—Wines

SCOTCH

Liquors

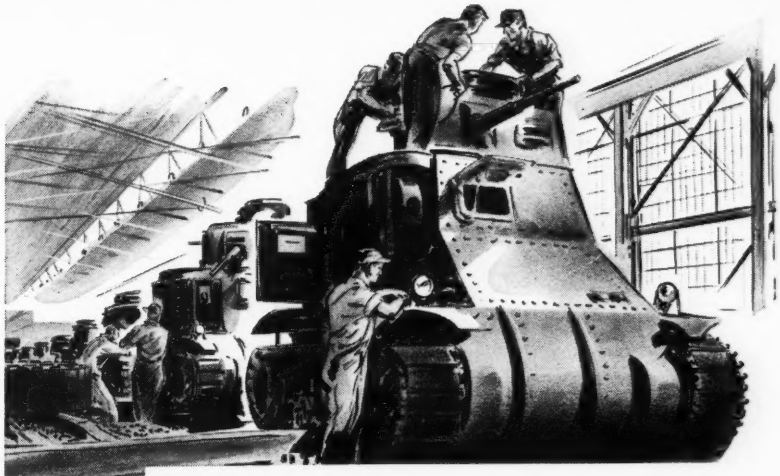
•

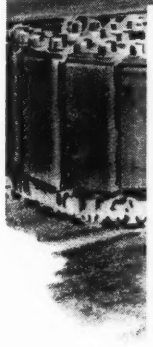
Buy a Case

•

218 E. State St. — Phone 2108

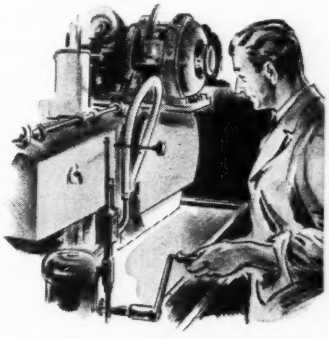
The wheel that cuts tank armor like a sharp knife slices bread!





When steel men made tank armor that could withstand anti-tank fire, they put our army one up on the battlefield. But they posed a new problem in tank construction. Precision cutting of the armor plate is necessary at many places to insure contact for welding. But because of its toughness, ordinary mechanical cutting methods wouldn't do. What was the answer? With Carborundum Brand Cutting-Off Wheels, the 1-1/8" armor plate is now sliced like you'd slice a loaf of bread. And so accurately that mating parts fit perfectly.

These abrasive wheels have revolutionized cutting-off methods. Often of extreme thinness, they even perform such delicate operations as slotting the points of fountain pens! Today Carborundum-made Cutting-Off Wheels are used to cut plastics, glass, brick, tile, steel and non-ferrous metals in plate and bar stock ...faster, more safely, and more economically. In most cases further finishing is unnecessary.



America's war program has thrown a new spotlight on the vital role which abrasives play in industry. This role is one which Carborundum "know-how" and skill have helped to create. When you take your place in industry, you'll find these same facilities ready and able to render an invaluable service. The Carborundum Company, Niagara Falls, New York.

CARBORUNDUM
REG. U.S. PAT. OFF.
ABRASIVE PRODUCTS

Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company.

The College of Engineering

Cornell University

Offers Courses of Study in the Following Fields:

Civil Engineering

1. General four-year course leading to the degree of Bachelor of Civil Engineering. Options are offered in Administrative Engineering, Sanitary Engineering, Structural Engineering, Hydraulic Engineering, Transportation Engineering, and Geodetic Engineering.
2. Six-year course leading to the degrees of Bachelor of Arts and Bachelor of Civil Engineering.
3. Four-year course in Administrative Engineering in Civil Engineering leading to the degree of Bachelor of Science in Administrative Engineering.

Mechanical Engineering

1. General four-year course leading to the degree of Bachelor of Mechanical Engineering. Options are offered in the senior year in Power-Plant Engineering, Heat Engineering, Industrial Engineering, Automotive Engineering, Aeronautical Engineering, and Hydraulic Power-Plant Engineering.
2. Five-year course leading to the degree of Bachelor of Mechanical Engineering.
3. Six-year course leading to the degrees of Bachelor of Arts and Bachelor of Mechanical Engineering.
4. Four-year course in Administrative Engineering in Mechanical Engineering, leading to the degree of Bachelor of Science in Administrative Engineering.

Electrical Engineering

1. General four-year course leading to the degree of Bachelor of Electrical Engineering.
2. Six-year course leading to the degrees of Bachelor of Arts and Bachelor of Electrical Engineering.
3. Four-year course in Administrative Engineering in Electrical Engineering leading to the degree of Bachelor of Science in Administrative Engineering.

Chemical Engineering

1. Five-year course leading to the degree of Bachelor of Chemical Engineering.

Accelerated Programs Are Now Available in All the Above Fields.

Graduate Work

Courses leading to the Master's and Doctor's degrees are available in all the above fields.

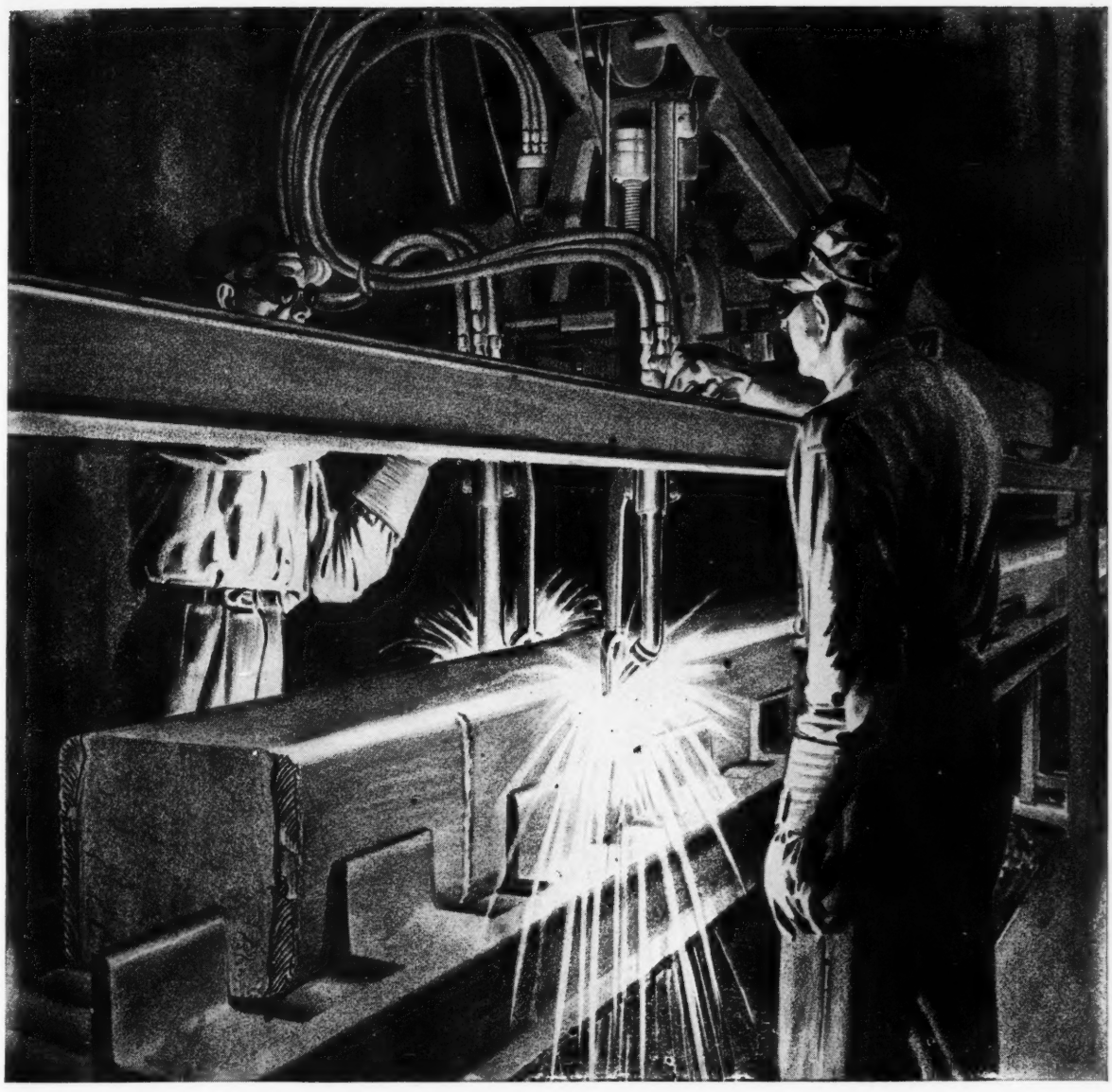
Engineering Research

Facilities are available for conducting fundamental and industrial researches in the foregoing fields in cooperation with industries.

For Detailed Information, Address

The Dean of the College of Engineering, Cornell University

Ithaca, New York



BILLETS TO BULLETS FASTER!

BY reducing billets to slugs faster, this recently perfected Airco machine gas cutting application speeds shell production. The Airco cutting torches — as many as ten can be mounted in this new Billet Nicking Machine — make simultaneous cuts a fraction of an inch into a billet, at a speed of from 20" to 30" per minute. After nicking, a sudden blow produces a clean break.

This new Airco developed cutting application reflects the ability of Air Reduction's Research and Development Engineers to quickly fulfill new industrial needs. Thus, Air Reduction customers are first to benefit from many oxyacetylene applications now speeding war production.

Even as they have revolutionized all-out war production, so in the peace to come these processes will show the way to better products, machines and structures at less cost.

To better acquaint you with the many things that this modern production tool does better we have published "Airco in the News", a pictorial review in book form. Write for a copy.

AIR REDUCTION

General Offices:

60 EAST 42nd STREET, NEW YORK, N.Y.

In Texas:
Magnolia-Airco Gas Products Co.
General Offices: HOUSTON, TEXAS
OFFICES IN ALL PRINCIPAL CITIES

ANYTHING AND EVERYTHING FOR GAS WELDING OR CUTTING AND ARC WELDING

STRESS and STRAIN...

Overheard in a bar . . .

"This war's going to be over in three months."

"Why?"

"My cousin Charley just joined the army, and he's never had a job for more than three months."

* * *

Dogs in Siberia are the fastest in the world because the trees are so far apart.

* * *

A bachelor is only a man who has cheated some poor woman out of a divorce.

The squad of recruits had been out to the rifle range for their first try at marksmanship. They knelt at 250 yards and fired. Not a hit. They moved up to 200 yards. Not a hit. They tried at 100 yards. Not a hit.

"Tenshun!" the sergeant barked. "Fix bayonets! Charge! It's your only chance."

—Western Reserve Red Cat

* * *

"Words are like leaves; and where they most abound,
Much fruit of sense beneath is rarely found."

—Pope

This Month's Gem from the Arts School . . .

"Why do you wear your stockings wrong side out?"

"Because there's a hole on the other side!"

* * *

She: "Do you know what good, clean fun is?"

He: "No, what good is it?"

* * *

. . . latest dope from the Office of Civilian Defense . . . "If a bomb hits you, don't go to pieces. Just lie still and no one will notice you."

—Dick Koppe

Demure Young Coed: "I swear that men's lips have never touched mine."

Sorority Senior: "That's enough to make any girl swear."

* * *

THESE FRESH KIDS

The pretty young teacher was explaining the difference between concrete and abstract.

"Concrete means something you can see," she said, "abstract, something you can't. Who'll give me an illustration?"

A boy in the front row raised his hand. "My pants are concrete," he said, "Yours are abstract."

It was Monday morning and a private went in to see the Army post doctor. He complained about a severe headache.

The Doctor said: "Perhaps you did too much drinking over the weekend?"

Private: "No, sir; I never touch liquor, don't like it."

Doctor: "Perhaps too much smoking?"

Private: "No sir; don't like tobacco."

Doctor: "Well, maybe you chased the girls around a little too much."

Private: "No sir; don't like girls."

Doctor: "Hell, all that's the matter with you is your halo is too tight."

—Arkansas Engineer

WHOOPS!

Smith (as plane goes into a spin): "Instructor, quick, what do I do now?"

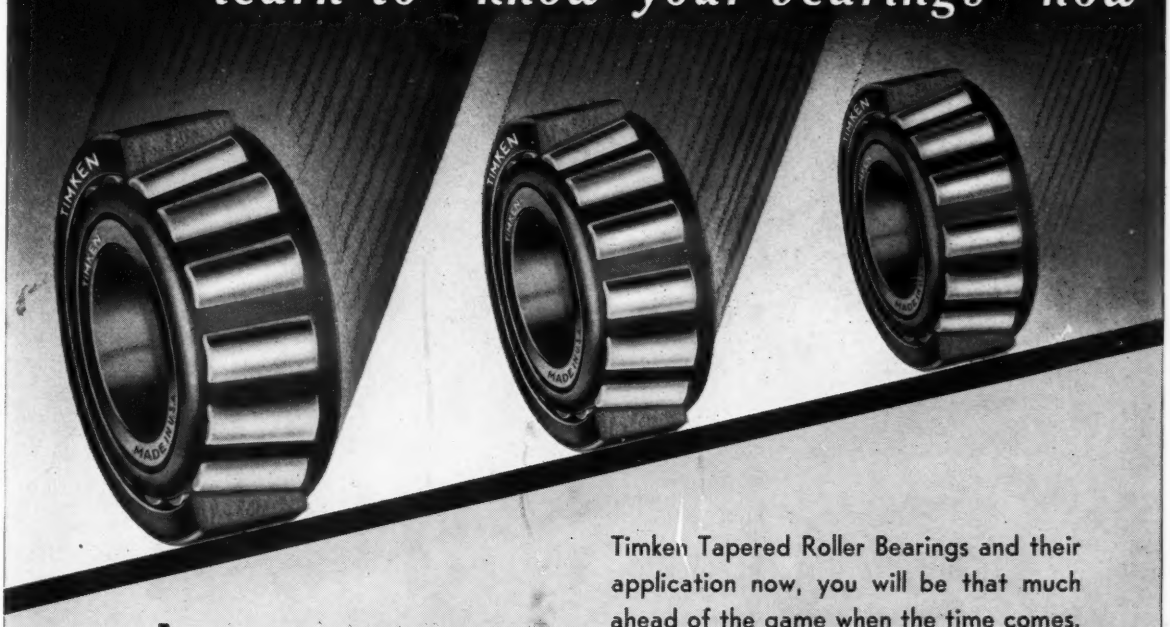
Adams: "Hell's bells! Aren't you the instructor?"

* * *

An old lady kept a parrot which was always swearing. She put up with this, but on Sunday she kept a cover over the cage—removing it on Monday morning. One Monday afternoon she saw her minister coming toward the house, so she again placed the cover over the cage. As the reverend gentleman entered the room, the parrot disgustedly remarked: "This has been a d - - n short week."

Prepare for post-war reconstruction—

learn to "know your bearings" now



A heavy part of the burden of world reconstruction following the United Nations' victory in the war will have to be borne by graduate engineers, now in school.

Revolutionary advancements in machines of all kinds will be the order of the day and, among other things, you'll have to know your bearings in order to be able to hold your own when competition gets tough.

By getting a sound basic knowledge of Timken Tapered Roller Bearings and their application now, you will be that much ahead of the game when the time comes, for you will be prepared to solve any bearing problem that ever is likely to come up.

Furthermore, through the intelligent use of Timken Bearings you will be able to create machines that not only *perform better,* but also *sell better*—for wherever civilization exists, no name in bearings means so much to the machine buyer as "TIMKEN".

Our engineers—specialists in bearing design and application—will be glad to help you in your study of Timken Bearings.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN

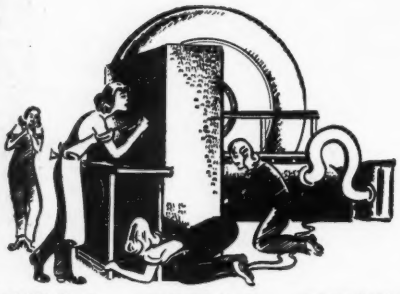
TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

G-E Campus News

U.S. Department of Commerce
Nat. Bureau of Standards
Washington, D.C.



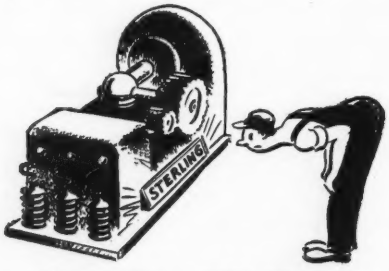
GIRLS, GIRLS, GIRLS

INASMUCH as only one-third of the 12,000 engineers who will graduate in 1943 will be available for private industry, General Electric is hiring young college women to do work formerly done by male engineers.

Four "test women" are on the job now, and [redacted] will report each week until the quota (150 [redacted]) is reached. The girls will make computations, charts, graphs, and calibrate fine instruments for use in the machine-tool industry.

Miss Virginia Frey (U. of Michigan), one of the 12 women in the country who received engineering degrees this year, is the only graduate engineer in the group. However, each of the others has majored in either mathematics or physics and has received training in both.

Although no one expects these girls to become full-fledged engineers, most of them will be given the Company's famous "test" course.



HI-YO, SILVER!

BROTHER, can you spare a dime?

Manufacturers don't really need it yet, but they are using more and more silver as other metals become increasingly difficult to get. G-E engineers, for example, are using silver in the manufacture of electric apparatus in order to conserve tin, copper, and other scarce materials.

There is now at least a little of the precious metal in almost every motor, generator, transformer, and other piece of equipment built by General Electric for the war.

In many cases the use of silver adds to the cost—a consideration secondary to production at present. Here its use is probably temporary.

But in current-carrying contacts and in brazing alloys, the use of silver results in an improvement in quality sufficient to justify the greater cost. For these purposes, silver will very likely be used in even greater quantities after the war.

TEST PILOT

THE versatile electronic tube has now become somewhat of a test pilot. On test flights, it goes along and writes a complete record of the strains on certain structural parts of the plane as it dives and twists and streaks across the sky.

When a fighter plane goes into a power dive at 500 miles an hour, for example, it has to withstand terrific strains. How great a strain is a vital question to the designer, who wants to know whether he can reduce the weight of the plane to give it greater speed.

Here's how the electronic tube helps furnish the answer to that question: strain gages measure minute changes in dimensions, converting them into tiny electric impulses which electronic tubes amplify sufficiently to drive a highly sensitive oscillograph galvanometer; the galvanometer makes a permanent record of the impulses on a photographic film. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

952-43-211